This is a digital copy of a book that was preserved for generations on library shelves before it was carefully scanned by Google as part of a project to make the world's books discoverable online.

It has survived long enough for the copyright to expire and the book to enter the public domain. A public domain book is one that was never subject to copyright or whose legal copyright term has expired. Whether a book is in the public domain may vary country to country. Public domain books are our gateways to the past, representing a wealth of history, culture and knowledge that's often difficult to discover.

Marks, notations and other marginalia present in the original volume will appear in this file - a reminder of this book's long journey from the publisher to a library and finally to you.

Usage guidelines

Google is proud to partner with libraries to digitize public domain materials and make them widely accessible. Public domain books belong to the public and we are merely their custodians. Nevertheless, this work is expensive, so in order to keep providing this resource, we have taken steps to prevent abuse by commercial parties, including placing technical restrictions on automated querying.

We also ask that you:

+ *Make non-commercial use of the files* We designed Google Book Search for use by individuals, and we request that you use these files for personal, non-commercial purposes.

+ *Refrain from automated querying* Do not send automated queries of any sort to Google's system: If you are conducting research on machine translation, optical character recognition or other areas where access to a large amount of text is helpful, please contact us. We encourage the use of public domain materials for these purposes and may be able to help.

+ *Maintain attribution* The Google "watermark" you see on each file is essential for informing people about this project and helping them find additional materials through Google Book Search. Please do not remove it.

+ *Keep it legal* Whatever your use, remember that you are responsible for ensuring that what you are doing is legal. Do not assume that just because we believe a book is in the public domain for users in the United States, that the work is also in the public domain for users in other countries. Whether a book is still in copyright varies from country to country, and we can't offer guidance on whether any specific use of any specific book is allowed. Please do not assume that a book's appearance in Google Book Search means it can be used in any manner anywhere in the world. Copyright infringement liability can be quite severe.

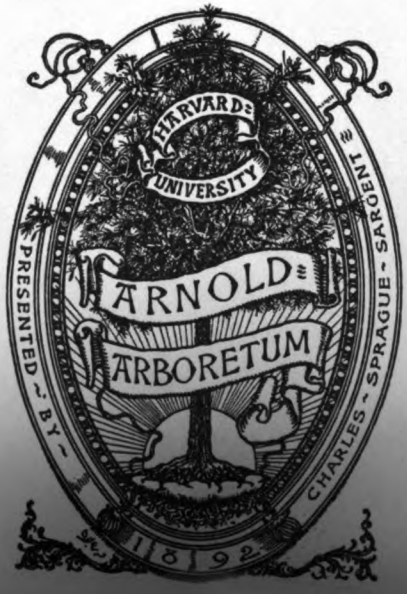
About Google Book Search

Google's mission is to organize the world's information and to make it universally accessible and useful. Google Book Search helps readers discover the world's books while helping authors and publishers reach new audiences. You can search through the full text of this book on the web at `http://books.google.com/`

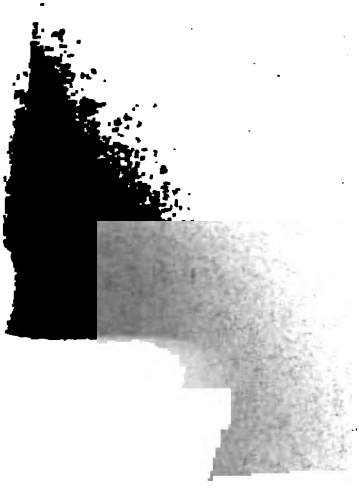
Digitized by Google

3 2044 106 347 396

Rare AU
24.1



Digitized by Google



Digitized by Google

Digitized by Google

TRANSACTIONS AND PROCEEDINGS

AND

REPORT

OF THE

ROYAL SOCIETY of SOUTH AUSTRALIA.

VOL. VII.

(FOR 1883-84.)

Adelaide:
G. ROBERTSON, 103, KING WILLIAM STREET.
1885.

Parcels for transmission to the Royal Society of South Australia, from Europe and America, should be addressed "per **W. C. Rigby**, care Messrs. Thos. Meadows & Co., 35, Milk Street, Cheapside, London."

Digitized by Google

33730
Mar 7, 1922

Royal Society of South Australia.

Patron:

HER MAJESTY THE QUEEN.

Vice-Patron:

HIS EXCELLENCY SIR WILLIAM ROBINSON, K.C.M.G., C.B., &c.

OFFICERS.

[Elected October 7, 1884.]

President:

PROF. H. LAMB, M.A., F.R.S.

Vice-Presidents:

H. C. MAIS, Esq., M.I.C.E.
H. T. WHITTELL, Esq., M.D. (Representative Governor).

Hon. Treasurer:

WALTER RUTT, Esq., C.E.

Hon. Secretary:

W. L. CLELAND, Esq., M.B.

Other Members of Council:

WALTER HOWCHIN, Esq., F.G.S. (Editor)
W. E. PICKELS, Esq., F.R.M.S.
R. L. MESTAYER, Esq., C.E.
D. B. ADAMSON, Esq.
CHAS. TODD, C.M.G.
W. HAACKE, Esq., Ph.D.

Assistant Secretary:

MR. A. MOLINEUX.

Digitized by Google

CONTENTS.

PAGE.

James Stirling: Notes on a Geological Sketch-Section through the Australian Alps (plates i. and ii.). 1

Samuel Dixon: Notes on the supposed Coal-beds of the Fitzgerald River 9

E. Meyrick: List of South Australian Micro-Lepidoptera 10

Clement L. Wragge: Remarks on the "Red Glow" 17

Professor R. Tate: Notes on the Physical and Geological Features of the Basin of the Lower Murray River (plate iii.) 24

J. G. O. Tepper: A Rare and Curious Hemipterous Insect (plate iii.A) 47

J. G. O. Tepper: A Beautiful and Rare Beetle (plate iii.A) 48

J. G. O. Tepper: Plants of Kangaroo Island 50

Charles H Harris: Variation of the Compass in South Australia (Abridged) 54

W. A. Jones: Notes on the Crepuscular Glimmer, or Red Glow .. 56

Professor R. Tate: Description of New Species of South Australian Plants 67

Professor R. Tate: Additions to the Flora of Extra-Tropical South Australia 72

MISCELLANEA.

BOTANY: Botanical Notes by Professor R. Tate: Additions to the Flora, Additional Localities for Plants, &c. 74

BIBLIOGRAPHICAL NOTICES: 1. Fossils from Mount Hamilton and Peak. 2. Cretaceous Fossils from Queensland. 3. Trilobites from South Australia 75

Abstract of Proceedings 77

President's Address 85

Donations to the Library 102

List of Fellows, Members, &c. 108

APPENDIX.

Transactions of Field Naturalists' Section 112

Digitized by Google

Digitized by Google

Notes on a Geological Sketch-Section through the Australian Alps.

By James Stirling, F.L.S., Corr. Member.

Plates I. and II.

[Read February 5, 1884.]

An examination of the different rock masses which compose the Australian Alps reveals many interesting geological features, not only in respect to their stratigraphical relations, but in the evidences of long-continued denudation which has laid bare the deep-seated crystalline schists and their intrusive rock masses. The surface configuration over which the sectional line has been determined is most varied, passing from the porphyritic bosses of the rugged Cobberas Mountains, across the Upper Silurian slates and marble-beds in the valley of Limestone Creek, through the metamorphic schists and granites of the Mitta-Mitta source-basin and its included Omeo plains and tableland, to the Main Dividing Range; thence across the deep gorge formed by the Dargo River (where the metamorphic schists merge into unaltered Lower Silurian slates and sandstones) to the basaltic tableland of the Dargo high plains, which has sealed up the river valleys of Miocene age.

The lithological characters of the different rock masses are as follows:—At A are a series of open mossy upland flats, forming a low gap in the Main Dividing Range. These flats are made up of deposits of Tertiary or Post-Tertiary gravels, containing stream-tin and fine gold, and rest on a bottom of decomposing granite. The gravels are overlain by a moderate depth of alluvium, held together by the thin wiry interlaced roots of various Alpine shrubs. Samples of stannite in a quartz matrix have been found in the ridges *in situ*, indicating a probable lode not far distant. On the spurs from Mount Pilot the granite merges upward into a coarse granitoid schist, while on a high lateral range proceeding westerly the latter rock passes into a series of highly-inclined argillaceo-mica schists.

Descending the southern slopes of Mount Pilot, towards Forest Hill, the open park-like basin of Coowambat Flat is reached; here are seen outcrops of yellowish to bluish and greyish shales, calcareous shales, and limestones, the last con-

Digitized by Google

taining numerous impressions of minute brachipoda and corals of alleged Middle Devonian age.*

These limestones and shales dip about N. 85° W. at 65°, and rest unconformably on the Silurian sediments to the north, and on the brownish fragmental quartz porphyries which make up the mass of the Cobberas Mountain to the south. Higher up on the north-west side of the Cobberas Mountain are isolated patches of reddish conglomerates, apparently younger than the shales of Coowambat.

On the eastern side of the Cobberas Mountain are seen dense, almost granitic, salmon-coloured porphyries, made up of translucent whitish quartz crystals and prisms of orthoclase-felspar imbedded in a reddish felsitic base, with plates of hexagonal mica of a greenish-bronze colour, and, according to the microscopic examination by my friend Mr. Howitt, F.G.S., "an amorphous, yellowish-green, apparently hydrated, mineral found sparingly in small cavities." The summit of Mount Cobberas consists of bosses of compact fragmental porphyries, having similar petrographical characters to those on the eastern side, with the addition of the imbedded fragments of indurated slate and other rocks, thus forming a trappean breccia. These fragmental porphyries are continuous on the south and south-west side of the mountain to the sources of the Native Dog Creek, where outcrops of fossiliferous limestone are observable. This limestone is similar to that at Coowambat, and probably of the same age; but, unlike the latter, it is wholly surrounded by the quartz porphyries, filling a pocket in these igneous rocks. From this place northerly across the Main Dividing Range towards Limestone Creek the porphyries are more silicious in character, stand out in large weathered blocks, and yield a gritty, although not unfertile, soil.

At Stony Creek, erosion has laid bare thick beds of fossiliferous limestone, marble and slaty shale, the first containing among other molluscs the well-known *Spirigerina reticularis*, common to Upper Silurian and Lower Devonian formations, and undescribed species of *Beyrichia* and *Atrypa*. The marble beds are crowded with stems of *Actinocrinus* and obscure impressions of trilobites.†

The unaltered fossiliferous limestones, at this place, are in direct contact with the overlying porphyries, while the crystallization of the rocks increases with the depth. This would appear to confirm the suggestions made by Mr. Howitt

* "Devonian Rocks of North Gippsland," by A. M. Howitt, F.G.S.

† "On Caves Perforating Marble Deposits, Limestone Creek," by J. Stirling, F.L.S. Trans. Roy. Socy. Vict., 1883, p. 11.

Digitized by Google

in his valuable paper on the Devonian rocks of North Gippsland, viz., that "the great masses of quartz porphyries" (such as those I have described, p. 2) "are the denuded stumps of the volcanoes, around which accumulations of felstone ash and agglomerate, with felsitic rocks of indefinite character are seen to be grouped."* In other words, they are the last traces, though obscure as to their original characters by metamorphism, of the once trachytic ash and agglomerates of Upper Palæzoic volcanoes.

Crossing the spur dividing Stony Creek and Limestone Creek, the porphyries are seen to be penetrated by strings and veins of quartz, and in some places to assume an almost vesicular appearance. At lower levels towards Limestone Creek, the sedimentary rocks again appear, consisting of finely-laminated slates, sandstones, and interbedded bands of whitish marble or dense blue limestone, dipping W. at 70°. The marble bands are from 10 to 250 feet thick, more saccharoidal than the Stony Creek deposits, but full of seams of limonite, parallel to the bedding planes, and much jointed; they are also perforated by numerous caves. On the grassy sub-alpine flats of Limestone Creek are deposits of auriferous Tertiary gravels from 5 to 12 feet deep. Ascending the steep spurs to the west, the slates become more corrugated and micaceous. On the upland flats, near the crest of the range, masses of diorite are seen; the rich carpeting of grasses proving the fertility of the soil decomposed from these potash-yielding rocks. These intrusive masses are probably connected with the periods of Palæozoic volcanic activity, as the rocks at contact are indurated and otherwise altered. As the crest of the range is reached, the slates become very much corrugated, micaceous, and full of quartz veins; further to the north, along the line of these semi-altered slates, veins of micaceous iron-ore are plentiful in a quartz matrix. On the crests of the range the rocks assume a vertical dip and decidedly metamorphic character as gneissose schists; while in descending towards Marengo Creek masses of granite are seen standing out in huge tors. This is probably a metamorphic granite, and is continuous across the valley of the Marengo Creek to Mount Leinster, which is a bold rounded peak on the Dividing Range. At the summit of this mountain the granite gives place to quartz-porphyry of an intrusive character, which has apparently been exposed by sub-aerial denudation.

On the west side the metamorphic schists are constituted of argillaceous, argillaceo-micaceous, and areno-argillaceous materials dipping from vertical to 85° to W. On the slopes

* "Devonian Rocks of Gippsland;" p. 200.

Digitized by Google

towards Morass Creek, masses of quartz-porphyry are again seen, the argillaceous rocks at contact assuming a jaspery silicified appearance. The gradual passage from the unaltered Silurian sediments into mica schist, gneiss and granite, plainly to be seen on the outer margin of the metamorphic area at Omeo, is in striking contrast to the sharp well-defined line of demarcation between the intrusive porphyries and the argillaceous sediments they invade. The metamorphic schists occupy the bed of Morass Creek, and are overlain by a considerable depth of alluvium, where crossed by the line of section. Ascending the thickly-wooded slopes of Mount Brothers the schists give place to a ternary granite similar in texture to that occupying the valley of the Marengo Creek, but towards the crest of the mountain, the latter is replaced by a distinct porphyritic granite, made up of large prismatic crystals of whitish felspar scattered through a base of smaller felspathic crystals, with quartz and black mica. The huge blocks which occupy the crest of the mountain stand out in rounded masses, exfoliating in concentric layers. Descending to the south, towards Omeo Plains, the metamorphic schists, which underlie this lacustrine area, appear to pass downward into a metamorphic granite; while to the east, at Mount Sisters, about three miles distant, are bluffy outcrops of an intrusive granite, which further to the east passes into a quartz-porphyry.

The Omeo Plains consist of about 16,000 acres of splendid agricultural land; fine open plains, with the Omeo Lake in their centre. Some idea of the fertility of these sub-alpine tablelands may be gleaned when it is stated that in 1882 fifty to sixty bushels of wheat to the acre was not an uncommon yield. On the southern margin of these plains, towards Omeo, are open, well-grassed ridges, showing outcrops of mica and argillaceo-mica schists; further to the south, at Smoking Gully Hill, are bands of nodular argillaceous schist, intersected by brownish quartz porphyry dykes and seams of igneous, probably diabasic, rock. At lower levels, these argillaceo-mica schists pass into hard crystalline rocks, gneissose and quartzitic schist very much ramified by numerous igneous and intrusive dykes; these are well seen in the bed of Wilson's Creek, an affluent of Livingstone Creek. Ascending the rounded eminence to the south, known as Day's Hill, a mass of intrusive granite is seen to have been lain bare at the crest of the hill. The schistose rocks at contact are very much altered, assuming the character of hornfels. The rough sketch represented by plate II. will serve to illustrate the peculiar features of this intrusive mass, and also indicate the position of the alluvial gold workings in the bed of an ancient lake or tarn, which extended, in Tertiary

Digitized by Google

times, from the base of Day's Hill to Mount Livingstone. At Day's Creek, on the southern base of the former hill, erosion has lain bare several interesting sections of the strata, showing numerous intrusive dykes intersecting the beds of quartzite, gneiss, and mica schist, which form the metamorphic rocks at this place. These dykes are dioritic, felsitic and, probably, diabasic, and have all altered the bounding rocks to a more or less distance from contact. One noticeable feature of them is that the mica schists, in the passage downwards, pass into a rock resembling that variety of the felspar-group known as porphyritic gneiss.

On the western slopes of Day's Hill are deposits of Tertiary auriferous gravels, fully 100 feet above the present level of Livingstone Creek. These gravels form part of what was evidently a continuous mass extending to the base of Mount Livingstone, about three miles distant, and now partially degraded by the erosion of the Livingstone Creek. The upper portion of these deposits consists of rounded fragments of various rocks, now found *in situ*, such as quartz, mica schist, gneiss, felstones, diorites, &c., in every stage of decay, from exfoliation in concentric layers to kaolin and magnesian clay. It is at the bottom of these gravels that the auriferous wash-dirt occurs. At Dry Hill, near Mount Livingstone, they have been exposed by mining operations to a depth of 60 feet, and are here seen to rest on what is locally called a "false bottom" of decomposing boulders of igneous rock of larger dimensions, to a depth of 40 feet, where the bed rocks occur. The boulders are evidently derived from volcanic caps similar to those remaining *in situ*. The bed of the ancient lake has been eroded on three sides, and the surrounding hills degraded. It is stated that there are at least four of these lake basins along the valley of the Livingstone Creek, which have been drained by the creek having cut through their margins.

In the basin of Dry Gully (one of the creeks which has eroded its passage along the margin of the ancient lake) are rich auriferous reefs, intersecting the metamorphic schists, the quartz becoming highly pyritous at a depth of 100 feet and lower. The following minerals have also been found in the neighbourhood:—Phosphate, carbonate and sulphide of lead, silicate and carbonate of copper, native silver, argentiferous galena, rutile, black tourmaline plentiful in quartz seams, fibrolite, micaceous iron-ore, &c. From Mount Livingstone, which is made up of argillaceous and micaceous schists with bands of nodular argillaceous schist and gneiss, the sectional line crosses some fine uplands of limited extent, as at Jim and Jack and Parslow's Plains, where large masses of granite are seen to form the principal rock. On the spurs to the east of

Digitized by Google

Parslow's Plains, there are signs of silicification and induration with numerous felsitic dykes, indicating an intrusive granite; but on the western side towards Mount Parslow, the granitic rock masses appear to pass upward into coarse gneiss and mica schists—the gneissic rocks forming the principal mass in the bed of the Victoria River. From the Victoria River to the crest of the Main Dividing Range the rocks are principally metamorphic, veined with white quartz and intersected by dioritic and felsitic dykes; but in descending towards the Dargo River the gradual passage from gneissose rocks to mica schist, thence to micaceous shales and the unaltered Silurian slates and sandstones is plainly seen. On King's Spur there is also a leptynite schist containing decomposed garnets, and a band of rock composed of quartz and green hornblende.*

Ascending what is known as Mayford Spur on the west side of the Dargo River, the slates and sandstones are continuous for about 1,400 feet above the level of that river, where they are seen to be overlain by deposits of heavy auriferous gravels, with bands of foliated sandy clay containing impressions of the Miocene plant *Cinnamomum polymorphoides*, McCoy. In this locality at similar levels are masses of silicious conglomerates and ferruginous bands containing imperfect Lauraceous leaves and *Salisburia Murraya*, McCoy, nearly allied to some Miocene forms from the arctic regions.† These Miocene deposits are overlain by extensive sheets of basalt, forming the Dargo High Plains at elevations of from 4,000 to 5,000 feet above sea level. As this section traverses an extent of territory not yet examined by the Geological Survey of Victoria, it may be interesting to conclude with an outline of the probable stratigraphical relations of the different rock masses.

Silurian.

There does not appear to be any remnants of Pre-Silurian or Archæan rocks within the area; it is not improbable, however, that the Palæozoic volcanic and plutonic activities have completely transmuted any such Archæan sediments into the granitic masses, now laid bare by denudation within the Lower Silurian areas. The great mass of metamorphic schists, &c., would appear to be simply the metamorphosed Lower Silurian sediments, although there are not wanting evidences that the Upper Silurian rocks have been tilted, folded, and compressed along with the Lower Silurian, and, like them, subjected to the influence of metamorphic action. Mr. Selwyn remarks‡

---

* "Progress Report Geol. Surv., Victoria, 1878," p. 98.

† "Progress Report Geol. Surv., Victoria," vol. 5.

‡ "Intercolonial Exhibition Essays."

Digitized by Google

that there is considerable unconformability between the Upper and Lower Silurian rocks of Victoria, which would appear to indicate that the Lower Silurian were subjected to considerable denudation, and to periods of plutonic activity before the upper beds were laid down. Whether the regional metamorphism of the Mitta Mitta source basin is connected with plutonic forces during Silurian times by the lowering of the area within the influences of central heat, which would recompose and crystallise the lower portions of the crumpled Palæozoic sediments, or are the "latest results of that general process of transmutation, which all sedimentary deposits have undergone and are still undergoing from the moment they begin to be covered more or less thickly with other more recent deposits," is still a matter of uncertainty. The researches of Mr. Howitt* among the Devonian rocks of Gippsland have unmistakeably shown that the close of the Silurian or the beginning of the Devonian periods in the Australian Alps was one of powerful volcanic activity, during which the porphyries of Mount Cobberas and adjacent mountains were laid down as accumulations of ash or tufa, subsequently consolidated; and there is every probability that the intrusive porphyries, which have invaded the metamorphic schists, are connected with the volcanic and plutonic activity of that time.

Devonian.

The representatives of this system, crossed by the line of section as at Coowambat and Native Dog Creek, are indicated by the fossils to be Middle Devonian, and as they are evidently superior to the porphyries upon which they rest unconformably, the latter may provisionally be classed as Lower Devonian. The absence of Lower Devonian sediments is noticeable—indeed, I am not aware that any such exist in Victoria. The Middle Devonian formation is well developed in the isolated patches of limestone at Bindi, on the Tambo River, and Buchan, on the Buchan River, to the south from the line of section. At both of these places an abundance of its characteristic fossil, *Spirifera levæcosta*, may be collected; while at Mount Tambo, to the east of the Omeo Plains, bold outcrops of purple conglomerates and sandstones are seen, apparently stratigraphically superior to the marine limestones at Bindi, and are regarded by Mr. Howitt as of Upper Devonian age.* All these Devonian areas form now mere pockets in the land surface, indicating vast periods of time, during which the oscillations of the surface resulted—first, in subsidence, during which they were laid down on the bed of the ocean; and, second, in emergence and folding, occasioned

* "Devonian Rocks of Gippsland," A. M. Howitt, F.G.S.

Digitized by Google

probably by plutonic and volcanic action; and, thirdly, in extensive sub-aerial denudation when the crests of the curves were removed.

Miocene Tertiaries.

From the laying down of the Upper Devonian sediments to the sealing up of the Miocene valleys by the lava-flows, there is a manifest break in the continuity of geological formation, which can only, I think, be accounted for by supposing, either that powerful denudation has removed any remnants of Mesozoic formations, or that volcanic activities, which terminated the Devonian period, raised the land surface to above sea level so that no Mesozoic sediments were deposited. To the north of the line of section, are other and more extensive lava-flows covering Miocene river-beds, as at Bogong High Plains, 6,000 feet above sea level. The extent and geotectonic features of this area, indeed, of the whole of the area embraced by the Tertiary basalts, have been so ably delineated by the Government geologist, Mr. Murray,* that I must refer those desirous of obtaining valuable information on these areas to that gentleman's published reports. It may, however, be interesting to note that according to the petrographical examinations by Mr. Howitt, no good distinction exists either in structure or composition between the so-called older and newer basalts of Victoria (among the latter have been classed the basalts of the Western District). To those desirous of obtaining complete scientific knowledge of the structure and composition of the intrusive rocks invading the metamorphic areas, Mr. Howitt's contributions† to the subject will be specially valuable, leaving nothing to be desired on the score of accurate information of the structural and stratigraphical relations of the rock masses within the areas he has examined. As this gentleman is at present assiduously working at the area south from the line of section described in this paper, his determinations of the composition of the dykes and intrusive masses may be looked forward to with considerable interest. In the meantime, the information supplied may not be without interest to geological readers.

---

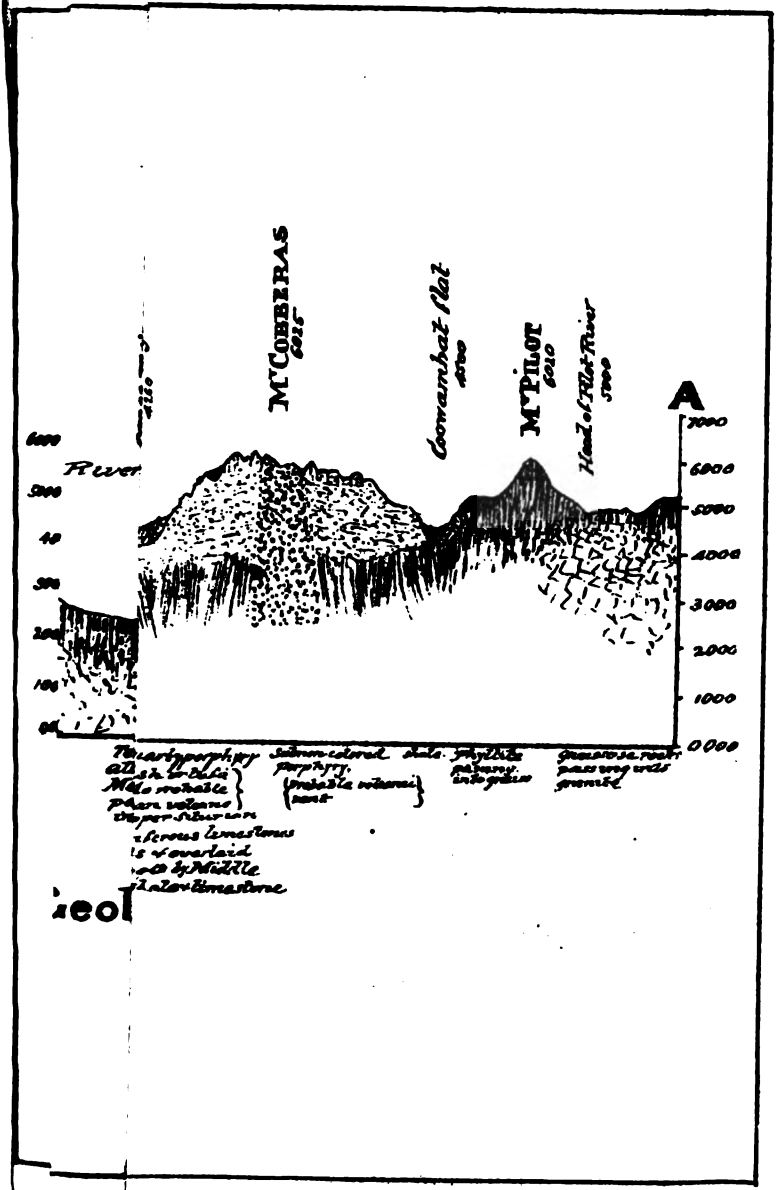
* "Geol. Sur., Victoria,—Dargo and Bogong," vol. 5.

† "Granites and Diorites of Swift's Creek," by A. W. Howitt, F.G.S. Trans. Roy. Soc., Victoria.

"Rocks of Noyong," Trans. Roy. Soc., Victoria, 1883.

Digitized by Google

Plate I.



a similarly dry climate.

Digitized by Google

Digitized by Google

VGSTONE

as represent the original shore of the sea of that p... further think it will be found that in general characte the flora then was very similar to the present, and belong a similarly dry climate.

Digitized by Google

Digitized by Google

Notes on the Supposed Coal-beds of the Fitzgerald River.

By Samuel Dixon.

(From a letter addressed to Professor R. Tate.)

[Read February 5, 1884.]

As to the mineral pitch or bituminous substance reported for years past to exist in Kangaroo Island, I feel positive, it is washed up by the sea and perhaps borne by it a considerable distance.

In 1867, I spent a long time on the south coast of West Australia searching for it, and found it in every case, undoubtedly brought there by the sea, as the whole littoral between Cape Arid and Doubtful Island Bay is Post-Miocene resting on granite and micaceous schists

I was induced to make the expedition owing to the late Mr. Roe, Surveyor-General of Western Australia, reporting the existence of coal on the Fitzgerald River; and it was thought some connection might exist between the known occurrence of the bitumen and the reported beds of coal; but unfortunately for the theory and myself too, the supposed coal was nothing but a few very thin beds of brown lignite more or less mixed with quartz pebbles and with fragments of gum of the grass-tree and portions of the seed vessels and leaves of Eucalypts, and seemed to me undoubtedly of the same geological age as the bright-hued sandstones—green, purple, pink, &c.—which are cut through by the Fitzgerald and its trifling tributaries.

I am also of opinion that Mr. Gregory is mistaken in reporting this bed of lignite as resting unconformably on carboniferous shales (see Proceedings of the Geological Society for 1861, p. 480), as there are no shales of that character, but only metamorphic sandstones, jaspers and micaceous schists, the latter being similar to those exposed by the sea close to the bore made by Messrs. O'Halloran and others on the neck at Kangaroo Island.

The only interest this bed possesses will, I think, be found in its containing the flora of the period of depostion of the Murray Cliffs; and the sandstones of the Fitzgerald seem to me to represent the original shore of the sea of that period and I further think it will be found that in general characteristics the flora then was very similar to the present, and belonged to a similarly dry climate.

Digitized by Google

List of South Australian Micro-Lepidoptera.

By E. Meyrick, B.A.

[Read July 8, 1884.]

The following list includes all the described species of *Micro-Lepidoptera* known to me as inhabiting the colony of South Australia—about 180 in all. Besides these, however, I possess many others as yet undescribed, which cannot therefore be included here. The whole form only an insignificant fraction of the number probably occurring, which I estimate at not less than 4,000. The main purpose of the list is thus to convey to residents in the colony some idea of the work which lies before them in the discovery and study of these groups. In the identification of specimens, and in any other respects, I shall always be very glad to assist any who may care to communicate with me.

The species hereafter given were mostly taken by myself during a collecting tour made in 1882. I collected round Adelaide and on the Mount Lofty Range early in October, and at Quorn, Petersburg, and Wirrabara Forest later in the month; at the beginning of November I passed through Wallaroo, and paid a visit to Port Lincoln; and in the middle of the same month I was at Mount Gambier. I examined also the collection made by Mr. E. Guest, of Balhannah, on the Mount Lofty Range, and that in the possession of the University Museum; also a few species collected by Prof. Tate and the Rev. T. Blackburn. To these and my other South Australian friends I am, moreover, indebted for much kindness and valuable assistance during my visit.

Those species marked with an asterisk are not yet known to me as occurring outside South Australia.

The undescribed species which I obtained will be found published from time to time in my papers in the "Proceedings of the Linnean Society of New South Wales," the "Transactions of the Entomological Society of London," and elsewhere.

PYRALIDINA.

Epipaschiadæ.

*Catamola funerea, *Walk.* Ardrossan.
elassota, *Meyr.* Quorn.
Stericta habitalis, *Gn.* Mount Lofty, Ardrossan.

Digitized by Google

PYRALIDIDÆ.

*Balanotis hercophora, *Meyr.* Port Darwin.
Ocrasa albidalis, *Walk.* Mount Lofty.
Asopia farinalis, *L.* Mount Lofty; introduced from Europe.
Oenogenes fugalis, *Feld.* Mount Graham.
Persicoptera pulchrinalis, *Gn.* Mount Lofty.

MUSOTIMIDÆ.

Musotima ochropteralis, *Gn.* Mount Lofty.

HYDROCAMPIDÆ.

Paraponyx nitens, *Butl.* Lake Alexandrina.

BOTYDIDÆ.

Pachyarches psittacalis, *Hb.* Port Darwin.
Phacellura indica, *Saund.* Port Darwin.
Glyphodes excelsalis, *Walk.* Port Darwin.
diurnalis, *Gn.* Port Darwin.
Sceliodes cordalis, *Dbld.* Mount Lofty.
Nomophila noctuella, *Schiff.* Mount Lofty, Wirrabara, Port Lincoln.
Hellula undalis, *F.* Mount Lofty, Quorn, Port Lincoln.
Mecyna polygonalis, *Hb.* Adelaide, Quorn, Port Lincoln. Larva on *Templetonia egena* and *T. retusa*.
*Metallarcha calliaspis, *Meyr.* Petersburg, Port Lincoln; amongst *Beyeria opaca*.
*Metallarcha diplochrysa, *Meyr.* Petersburg, Port Lincoln, Beachport; amongst *Beyeria opaca*.
*Metallarcha epichrysa, *Meyr.* Quorn, Petersburg; amongst *Dodonæa lobulata*.
*Metallarcha eurychrysa, *Meyr.* Ardrossan.
*Eurycreon xenogama, *Meyr.* Adelaide (foot of the range).
capnochroa, *Meyr.* Port Lincoln.
*Criophthona finitima, *Meyr.* Quorn.
Sedenia rupalis, *Gn.* Quorn, Port Lincoln, Kangaroo Island.
cervalis, *Gn.* Mount Lofty, Wirrabara.
Tritæa ustalis, *Walk.* Adelaide, Wirrabara, Ardrossan.

SCOPARIADÆ.

Eclipsiodes crypsixantha, *Meyr.* Port Lincoln.
Tetraprosopus Meyrickii, *Butl.* Mount Gambier; on trunks of Eucalyptus.
Xeroscopa philonephes, *Meyr.* Mount Lofty.
*Scoparia epicryma, *Meyr.* Mount Gambier.
eremitis, *Meyr.* Wirrabara.
* homala, *Meyr.* Adelaide; on fences.
spelæa, *Meyr.* Wirrabara, Mount Gambier.

Digitized by Google

CRAMBIDÆ.

Thinasotia bivittella, *Don.* Adelaide, Ardrossan.
relatalis, *Walk.* Mount Lofty.
opulentella, *Z.* Mount Lofty.
grammella, *Z.* Mount Lofty.
lativittalis, *Walk.* Ardrossan.
Diptychophora ochracealis, *Walk.* (præmaturella, *Meyr.*). Adelaide, Mount Gambier.
Ptochostola dimidiella, *Meyr.* Penola.

PHYCIDIDÆ.

Ceroprepes almella, *Meyr.* Ardrossan.
Tylochares cosmiella, *Meyr.* Mount Lofty, Wirrabara.
Cateremna leucarma, *Meyr.* Mount Lofty.
subarcuella, *Meyr.* Ardrossan.
Zophodia (?) ensiferella, *Meyr.* Mount Lofty, Port Lincoln.
Eucarphia vulgatella, *Meyr.* Mount Lofty, Ardrossan, Port Lincoln.
Etiella chrysoporella, *Meyr.* Adelaide, Quorn.
Behrii, *Z.* Mount Gambier, Adelaide, Wirrabara, Port Lincoln.
Salebria oculiferella, *Meyr.* Mount Lofty, Ardrossan.
* gypsopa, *Meyr.* Adelaide, Port Wakefield.
*Heosphora euryzona, *Meyr.* Wirrabara.
Crocydopora stenopterella, *Meyr.* Adelaide, Wirrabara, Quorn, Port Lincoln.
Homœosoma vagella, *Z.* Mount Gambier, Adelaide, Wirrabara, Port Lincoln.
Anerastia distichella, *Meyr.* Wirrabara, Port Lincoln.
Ephestia elutella, *Hb.* Adelaide—introduced from Europe.

GALLERIADÆ.

Aphomia latro, *Z.* Adelaide.

TORTRICINA.

GRAPHOLITHIDÆ.

Scolioplecta comptana, *Walk.* Mount Lofty.
Aphelia lanceolana, *Hb.* Mount Lofty; a cosmopolitan species.
Stigmonota iridescens, *Meyr.* Adelaide.
Crocidosema plebeiana, *Z.* Mount Lofty, Port Lincoln; introduced from Europe.
Palæobia anguillana, *Meyr.* Port Lincoln.
fidana, *Meyr.* Adelaide.
Holocola perspectana, *Walk.* Quorn, Port Lincoln.
biscissana, *Meyr.* Wirrabara, Port Lincoln.
Strepsiceros ejectana, *Walk.* Port Lincoln.
macropetana, *Meyr.* Mount Gambier, Mount Lofty, Wirrabara, Port Lincoln.

Digitized by Google

TORTRICIDÆ.

Dichelia mediana, *Walk.* Mount Lofty.
isoscelana, *Meyr.* Mount Lofty.
Capua chimerinana, *Meyr.* Mount Lofty.
melancrocana, *Meyr.* Mount Lofty.
Pyrgotis insignana, *Meyr.* Mount Lofty.
Acropolitis dolosana, *Walk.* Mount Lofty.
lignigerana, *Walk.* Mount Lofty.
signigerana, *Walk.* Mount Lofty.
Isochorista ranulana, *Meyr.* Mount Lofty, Wirrabara.
panæolana, *Meyr.* Mount Lofty.
Proselena annosana, *Meyr.* Wirrabara.
Palæotoma styphelana, *Meyr.* Mount Lofty.
Cacœcia lythrodana, *Meyr.* Mount Lofty.
postvittana, *Walk.* Mount Gambier, Mount Lofty, Port Lincoln.
Cacœcia liquidana, *Meyr.* Mount Lofty, Wirrabara, Port Lincoln.
Cacœcia tessulatana, *Meyr.* Wallaroo, Port Lincoln.
Tortrix subfurcatana, *Walk.* Mount Lofty.
glaphyrana, *Meyr.* Mount Lofty, Port Lincoln.
indigestana, *Meyr.* Port Lincoln.
standishana, *Newm.* Mount Lofty.
Dipterina rupicolana, *Meyr.* Mount Lofty.
Arotrophora arcuatalis, *Walk.* Mount Gambier, Wirrabara.

CONCHYLIDIDÆ.

Heliocosma incongruana, *Walk.* Mount Lofty.
Heterocrossa neurophorella, *Meyr.* Mount Lofty.

TINEINA.

GELECHIADÆ.

Bryotropha simplicella, *Walk.* Adelaide.
Lita solanella, *Boisd.* Adelaide.
Gelechia aversella, *Walk.* Quorn, Wirrabara.

CRYPTOLECHIADÆ.

Cryptophasa unipunctana, *Don.* Mount Lofty.
Chalarotona parabolella, *Walk.* Mount Lofty.

DEPRESSARIADÆ.

Semnoceros radiosella, *Walk.* Mount Lofty.

OECOPHORIDÆ.

Palparia aurata, *Walk.* Mount Lofty, Ardrossan.
semijunctella, *Walk.* Ardrossan.
uncinella, *Z.* Port Lincoln.

Digitized by Google

Eochroa callianassa, *Meyr.* Mount Lofty.
dejunctella, *Walk.* Mount Lofty.
protophaës, *Meyr.* Mount Lofty.
Heliocausta severa, *Meyr.* Wirrabara.
elæodes, *Meyr.* Mount Lofty.
* paralyrgis, *Meyr.* Mount Lofty.
parthenopa, *Meyr.* Mount Lofty.
euselma, *Meyr.* Mount Lofty.
Hoplitica sobriella, *Walk.* Mount Lofty.
repandula, *Z.* Mount Lofty.
pudica, *Z.* Mount Lofty.
*Eulechria episema, *Meyr.* Mount Lofty.
* leucophanes, *Meyr.* Port Lincoln.
* tanyscia, *Meyr.* Mount Gambier, Adelaide, Petersburg.
*Eulechria sciophanes, *Meyr.* Quorn.
* ombrophora, *Meyr.* Quorn.
* acerræa, *Meyr.* Petersburg.
*Oenochroa endochlora, *Meyr.* Quorn, Wirrabara, Ardrossan.
Linosticha canephora, *Meyr.* Mount Gambier.
Phlœopola banausa, *Meyr.* Adelaide; darker than usual.
* exarcha, *Meyr.* Mount Gambier.
*Mesolecta psacasta, *Meyr.* Port Lincoln.
*Nephogenes philopsamma, *Meyr.* Wallaroo.
* æthalea, *Meyr.* Mount Gambier, Mount Lofty.
Philobota arabella, *Newm.* Mount Lofty.
* biophora, *Meyr.* Adelaide.
auriceps, *Butl.* Mount Lofty.
* hypocausta, *Meyr.* Adelaide.
* pedetis, *Meyr.* Mount Lofty, Wirrabara, Port Lincoln.
Philobota herodiella, *Feld.* Mount Lofty.
productella, *Walk.* Mount Gambier, Adelaide, Petersburg, Port Lincoln.
*Philobota crocobapta, *Meyr.* Port Lincoln.
pretiosella, *Walk.* Mount Lofty.
* brochosema, *Meyr.* Mount Lofty.
interlineatella, *Walk.* Port Lincoln.
xanthiella, *Walk.* Mount Lofty.
bimaculana, *Don.* Mount Lofty.
*Compsotropha charidotis, *Meyr.* Wirrabara.
Peltophora atricollis, *Meyr.* Mount Lofty.
argutella, *Z.* Mount Lofty, Wirrabara, Port Lincoln, Ardrossan.
Saropla cælatella, *Meyr.* Port Lincoln.
*Coeranica eritima, *Meyr.* Quorn, Wirrabara, Port Lincoln.
Coesyra dichrœlla, *Z.* Mount Lofty.

Digitized by Google

Coesyra distephana, *Meyr.* Port Lincoln.
basilica, *Meyr.* Wallaroo.
zygophora, *Meyr.* Port Lincoln.
parvula, *Meyr.* Mount Lofty.
* aspasia, *Meyr.* Port Lincoln.
* apothyma, *Meyr.* Petersburg.
*Microbela epicona, *Meyr.* Petersburg, Ardrossan.
Heterozyga coppatias, *Meyr.* Adelaide.
Oxythecta hieroglyphica, *Meyr.* Port Lincoln.
*Crepidosceles exanthema, *Meyr.* Quorn.
*Ocystola thymodes, *Meyr.* Quorn.
* tyranna, *Meyr.* Quorn.
* enoplia, *Meyr.* Port Lincoln.
* crystallina, *Meyr.* Mount Lofty.
* chionea, *Meyr.* Wirrabara.
* homoleuca, *Meyr.* Wirrabara.
Oecophora pseudospretella, *Stt.* Port Lincoln; introduced from Europe.
Crossophora suppletella, *Walk.* Mount Gambier.

GLYPHIPTERYGIDÆ.

Hypertropha tortriciformis, *Gn.* (desumptana, *Walk.*). Mount Lofty, Quorn, Port Lincoln.
Eupselia carpocapsella, *Walk.* Mount Lofty, Quorn.
theorella, *Meyr.* Quorn.
Glyphipteryx meteora, *Meyr.* Mount Lofty, Wirrabara.
palæomorpha, *Meyr.* Mount Gambier.
Phryganostola euthybelemna, *Meyr.* Wirrabara.

PLUTELLIDÆ.

Thudaca obliquella, *Walk.* Mount Lofty, Port Lincoln.
Plutella cruciferarum, *Z.* Adelaide, Wirrabara, Quorn, Port Lincoln; introduced from Europe.

TINEADÆ.

Chrysoryctis irruptella, *Walk.* Port Lincoln.
purella, *Walk.* Mount Lofty, Quorn.
Scardia (?) australasiella, *Don.* Wirrabara, Port Lincoln.
Blabophanes meliorella, *Walk.* Mount Lofty, Wirrabara, Port Lincoln.
Blabophanes ethelella, *Newm.* Wirrabara.
Tinea pellionella, *L.* Mount Lofty, Port Lincoln; introduced from Europe.

HYPONOMEUTIDÆ.

Endrosis lacteella, *Schiff.* Kingston, Mount Lofty; introduced from Europe.

Digitized by Google

GRACILARIADÆ.

Gracilaria alysidota, *Meyr.* Port Lincoln.
didymella, *Meyr.* Petersburg, Port Lincoln.

BEDELLIADÆ.

Bedellia somnulentella, *Z.* Port Lincoln.

Digitized by Google

Remarks on the "Red Glow."

By Clement L. Wragge, F.R.G.S., F.R. Met. Soc.

[Read May 6, 1884.]

After some preliminary observations, the author proceeds:—

It seems very evident that there exists even now some reflecting medium in the upper regions of our atmosphere altogether *abnormal* and at a great height, as evidenced by the prolongation of the intense glow apart from the ordinary phenomenon of twilight caused by common atmospheric refraction. What, then, is this medium? this great reflector that is the *primary* cause of these exquisite glows that invest our landscapes with such lurid unearthly tints, and call to mind the idea of life in Mars? From a scanty perusal of the masses of evidence and observation already accumulated, my present belief is that our planet is surrounded by an abormal envelope of *dust*, either cosmic or telluric. Once prove this—and its proof *appears* easy—and the "sun glow" phenomena may be explained, as pointed out by Prof. Michie Smith, of Madras, in accordance with facts illustrated by Mr. Aitken before the Royal Society of Edinburgh (Trans. R.S.E., vol. xxx., p. 337). The sun's rays as white light fall on the dust particles, whose minute spiculæ scatter and absorb, reflect, sift, and split up the rays at the proper angles, and with greater or less intensity, according to the thickness of the air strata and height of the reflecting medium. These spiculæ may assist the condensation of vapour into that light haze so generally observed, and cause ice spiculæ deep enough to give the effects of absorption, but not to such an extent as to form cloud. Hence I, at present, *insist* that vapour and meteorological factors, if they influence the displays at all—as I shall presently inquire—are entirely *secondary;* and as such modify and regulate the passage of light, so assisting in the production of that galaxy of varying tint and colour which we have so admiringly beheld. The determination of the nature of the primary reflecting layer, and to determine how it came to occupy its present position, are the chief points in the discussion. It has been argued that vapour is the *main* cause, absorbing certain of the sun's rays. I confess that this hypothesis appears to me wholly absurd and untenable. The cause, as I have al-

Digitized by Google

ready strongly emphasised, is abnormal. How, then, could vapour be the main cause? How is it that the aqueous vapour of our atmosphere never before (to my knowledge, at least) assumed this peculiar state? If there was such an abnormal amount of vapour high in the atmosphere as to give rise to sunsets and sunrises which by their wondrous beauty have astonished both savage and civilised men, at least no known factors in terrestrial meteorology could possibly have first occasioned it. Moreover, I shall show from my own observations that the spectroscope has denied the existence of this vapour on occasions of some of the finest sunset displays. I see no objection, however, to the main dust theory, and it can, I consider, equally be held under the hypothesis of either cosmic or telluric dust. Each is equally tenable, but analysis of collected material can only determine the truth. It is known that some 10,000,000 meteorites enter our atmosphere daily, their matter being dissipated in dust in the higher regions, at an average height of twenty to forty miles. This meteoric matter is trifling when compared with the volume of the atmosphere itself, which is said to weigh 5,178,000,000,000,000 tons, while only 182,500 tons of ordinary meteoric matter are precipitated yearly, if we take, according to Prof. Langley, an average of 500 tons of meteoric dust cast into our atmosphere each day. But the earth, as Mr. Ranyard supposes, may have encountered a huge meteoric zone of dust, which augmented to a vast extent the normal dust envelope with which we are surrounded.

Now, what are the objections to this theory of abnormal cosmic dust? First, Mr. Ellery, considering the major diameter of our elliptical orbit, declares it must be impossible, since such a zone must have a breadth of about 183,000,000 miles. This certainly appears to upset the hypothesis of cosmic dust. But let us for a moment consider. Our entire system, with its diameter of some 5,491,996,000 miles, is but an atom lost in the immensity of space; our gigantic sun, with his diameter of 852,900 miles, a star of the Milky Way, resembling in physical constitution, as the spectroscope proves, others of the so-called "fixed stars" of the Kosmos.

I ask, then, is it unthinkable that our *entire system*, in its lightning speed through space, should have encountered some gigantic zone of cosmic material enveloping the whole of it?

Next it is supposed that any cosmic material would be consumed by the heat of impact. Of this it is, I think, impossible to speak positively, as the amount of consumption and dissipation would bear a ratio to the velocity of impact and of the meteoric dust-belt, and such would probably offer little resistance to the atmosphere, being extremely fine and impalp-

Digitized by Google

able. Favouring the condensation of a hazy vapour it would, however, *primarily* give rise to the sun-glow. I shall presently endeavour to show why the dust does not fall quickly to the earth, no matter what may be its origin. Possibly it may be related to the cause of the zodiacal light, which, according to one hypothesis, is formed of myriads of solid particles.

Coming now to the telluric hypothesis, the mass of evidence relating to the Javan eruptions points strongly to Krakatoa as the cause. The eruptions commenced in May last, culminating in the fearful convulsions of August 26th. Consider the immense amount of volcanic dust erupted; counted probably by millions of tons of dust, and exceeding by far the dust contributed by meteorites during the whole year. Consider the tearing asunder of the atmosphere over that mighty furnace, and the height to which particles of dust would be launched. Some idea of the atmospheric wave generated is gathered from the fact that the barometer on board a steamer 150 miles distant rose and fell half-an-inch every two or three minutes, as reported by Mr. Bishop, of Honolulu. Observations show that this gigantic air wave was visible on the barometer curves at several stations for five days after its origin; that its velocity was 674 miles an hour, that it travelled before its extinction more than 82,200 miles, and that it passed 3¼ times round the entire circumference of the earth. ("Nature," No. 738, p. 182). Apart from the blood-red and green suns, showers of dust and pumice and other startling phenomena, of which we have heard so much, and which I pass by, my opinion as to Krakatoa being the cause is greatly strengthened by the overwhelming fact that material brought down by rain in Holland and snow in Spain—crystals of hypersthene, pyroxene, and magnetic iron with volcanic glass—has been proved to be identical with the matter found in the Java ashes. It is objected, with much reason, to this volcanic theory:—How could the dust have spread so rapidly as to reach Trinidad in a week, while it took double that time to travel to India and Ceylon. This objection seems as fatal to the volcanic hypothesis as does Mr. Ellery's to the meteoric one; and with our knowledge of the general distribution of atmospheric pressure at that season of the year, is a difficult one to meet. Our first thoughts are of the great low pressure areas of Central Asia at that summer season; and we wonder why the heavier air currents which set inland from over the cooler ocean to take the place of the heated ascending currents of the Asiatic continent, did not convey the dust to India first. Perhaps closer consideration will enable us to give a satisfactory answer. The eruption of Krakatoa took place in a zone of low barometer, in a branch of the equatorial calm belt. My own observations on

Digitized by Google

Ben Nevis have lately shown that *over* a surface low pressure area there exists a relatively high-pressure region, caused by the accumulation of the air in higher regions, carried upwards by the warm ascending currents; and especially must this be the case at great elevations in low latitudes. We have but a faint idea of the actual force of that eruption. It would at any rate carry volcanic dust far into the higher atmosphere, and land it safely on the high-pressure zone existing high over the calm belt. Bear in mind now that a similar high-pressure area existed in the upper atmosphere over the surface low-pressure areas of India and Central Asia; and that the tendency of motion of this lofty high-pressure was towards the southern hemisphere, where a general surface high-pressure existed, overtopped, as in the case of all surface anticyclones, by a relatively lower pressure. Thus currents from the upper atmosphere of Southern Asia would flow southwards to preserve equilibrium, and feed the surface high pressure of the southern hemisphere at that season of the year. These currents would (but only for a short time on account of its proximity) hinder the dust from approaching India, and would carry it southwards, causing the "red glows" to be experienced earlier in Australia and South Africa, for instance, than in European latitudes. But I have still to offer some explanation of the fact of the "red glow" phenomena travelling due west, via the Seychelles, Cape Coast Castle, and Trinidad, at the rate of nearly 70 miles an hour, reaching the latter place, 11,700 miles away, within a week. I see no way at present of accounting for this, but on the theory that, owing to the rapid rotation of the earth at the equator, viz., 507 yards a second, or 1,038 miles an hour, the *higher* atmosphere in equatorial region lags behind, causing a strong current to set westwards from the same causes that explain, for instance, the phenomena of the north-east and south-east trade winds; and the circulation of the tides assisted by the earth's rotation as a secondary result of the moon's attractive influence. This equatorial east wind, if such exists, is in the high-pressure zone over the calm belt, and sends off branches to northward or southward of the Line respectively to maintain the great systems of surface anticyclones in either hemisphere, according to the geographical distribution of land and water and the season of the year.

The objection that more dust should have been expelled to spread so widely will not hold in my opinion, as we have but a faint idea of the vast amount actually expelled and diffused by the currents as impalpable powder.

Lastly we have one common objection to the main dust theory, viz., How can the matter remain suspended for such a long period in opposition to that force which we call gravity?

Digitized by Google

It is pretty clear that the suspension over the weight of atmosphere of impalpable dust in the rarified regions may be prolonged for an indefinite period. Not that it has no tendency to fall. On the other hand, I conceive, as I have already hinted, that it is subject to great alterations of level, depending probably on barometric pressure, which may intensify or minimise the "sun-glow;" though, as I shall afterwards show, this connection is hardly determined. The upward currents in times of low barometer at the earth's surface, when—allowing for differences of altitude—a comparatively high or accumulated pressure (as I have already shown) seems to prevail aloft, would buoy it up, as an upward current does a feather or ordinary motes of dust; and it would keep playing over the tops of the upward currents on a plan analogous to the phenomena of the so-called "willow-leaves" on the solar photosphere which are reasonably supposed to be the tops or crests of the currents in the sun. If this is so, the objection to floating dust even higher than 40 miles—the traditional height of the twilight-producing atmosphere—is overcome. Again, according to Faraday, metallic gold, when minutely divided, required months to subside when suspended in water; and on this experiment I see no reason why the dust-powder should not remain suspended over the haze of vapour. But if objection is raised to these explanations of the suspension, we have the repulsive agency of electricity to account for it, as has already been suggested, assuming that the dust, if from Krakatoa, is negatively electrified. The particles would mutually repel each other, as in the case of electrified gold-leaf, and be repelled and buoyed up by the repulsive action of the earth.

I have endeavoured to meet the chief objections to the dust theory, and will now proceed to a few words in conclusion on the atmospheric or possible *secondary* causes of the "sun-glows."

My meteorological and spectroscopic observations in connection with the glow are very conflicting, and further discussion of them is necessary before I can see my way to establish a connection. That the glows have become intermittent, and have been observed to be less intense during times of low barometer, seems certain. This may be explained by supposing an abundance of absorbing vapour, meteorologically derived, which would be increased by the primary stratum of dust favouring condensation. So the red light of less refrangibility would be impeded or cut off and partly absorbed by the vapour of a low-pressure area, and we might expect the "red-glow" to be not so intense, while the more refrangible green and blue tints of the sunset would not be interfered with. I think Mr. Todd has also observed this minimum of intensity

Digitized by Google

during periods of low barometer. Under such conditions the dust would probably be at a higher level. The displays certainly seem to have been especially fine when the air was dry and the red light unimpeded, during times of high barometer; and at such times (considering the downpour of air upon the centre of an anticyclonic system) I conclude that the dust stratum is lower. For instance, near Warsaw, in Russia, on November 30th, 1883, barometer 30·16; January 2nd last, 30·46; and January 3rd, 30·27; on all of which days the "red-glow" is reported as being intense*. Prof. Piazzi Smyth also corroborates this. So to a certain extent do my own observations made at the Torrens Observatory, near Adelaide; but on other occasions the sunset displays seem to be entirely indifferent to barometric and hygrometric influences. I will give a few examples.

On January 28th the barometer was high—30·22 at sea-level—and the sunset and red "after-glow" magnificent—the latter appearing on the horizon about one hour and a quarter after sundown like some great fire. Relative humidity at 9 o'clock was 77 %, indicating a decidedly moist condition of the atmosphere for South Australia—hardly in accord with the dry air and high barometer theory so ably advocated by Professor Piazzi Smyth, but on this occasion I had not access to the spectroscope.

On January 30th the same phenomena were almost identical, but the barometer was *lower*, relative humidity *less*—69 %†—*yet* a broad nebulous band to the left of the D line in the spectrum indicated much moisture in the thick strata of the atmosphere. Under such spectroscopic conditions I should have expected that the red rays would have been stopped off and absorbed by the abundance of aqueous vapour shown by the spectroscope. In these two instances the results of observation appear decidedly conflicting.

On March 5th the glow was again magnificent, barometer at 30·07 and pressure gradually decreasing, with a *dry* surface atmosphere and north-easterly airs, the percentage of relative humidity at 9 p.m. being only 38.

On March 16th, under high pressure — 30·32 — there was another grand display; vapour tension and relative humidity were low—0·240 and 48 %‡ respectively—and the spectrum exhibited an intensely dry atmosphere. The *lemon yellow* band prevailed over the horizon, gradually changing to light orange, and ultimately becoming a blood red. This observation led

* These barometer values are means of the observations of Ad. Wentz'l, Jun., taken at Krasnicza Wola, Grodzisk.

† 9 p.m value.

‡ 9 p.m. values.

Digitized by Google

me to enter the following verbatim remark in my notes at the time:—"My spectroscopic observations of to-night, taken as they were about 5° above the horizon, *prove* unquestionably to my mind that these wondrous sunset phenomena are *not* due to vapour. Not even at that altitude was earth moisture detected of any note." It is, however, noteworthy that lemon-yellow effects have lately prevailed at sunset to the exclusion of the red, and that the telluric bands in the spectrum rapidly darken, indicating rapid absorption as the sun sinks.

Again, on April 7th:—"*No* deep red after glow was visible, yet the air, by hygrometer and spectroscope, was *dry*, and the red glow might have been confidently expected; and the barometer was high."

In conclusion, I have great difficulty at present in connecting these abnormal sunset effects absolutely with any meteorological factors of which we are cognisant at the earth's surface; and I can only look to the primary cause, high in the atmosphere, whose effects may be regulated by atmospheric conditions.

Digitized by Google

Notes on the Physical and Geological Features of the Basin of the Lower Murray River.

By Professor Ralph Tate, F.G.S., F.L.S., &c.

Plate III.

[Read June 3 and July 1, 1884.]

CONTENTS.

Introduction.
Physical Features of the Murray Plateau.
Hydrographical Notes.
River Alluvium.
Origin of the Gorge.
Sections of the Older Tertiary or Murravian.
Palæontology of the Older Tertiary.
Sections of the Newer Tertiary.
Leading Botanical Features.

Introduction.

Captain Charles Sturt entered what is now South Australian territory towards the end of January, 1829, and navigated the river Murray to its mouth. His published observations* remain to this day the only connected account of the physical and geological features of the Lower Murray-river.

"A Study about the River Murray" is the title of a paper read before this Society July 3, 1883, and of a pamphlet, privately printed, by Mr. S. Pollitzer. That work deals essentially with river hydraulics, though some geological matters are introduced.

Facts in support of a large loss of water of the river by subterranean drainage are put forth by Mr. Rawlinson in Trans. Roy. Soc. S. Aust., vol. I., pp. 124-126, 1878, and by myself in vol. IV., pp. 132-133, 1881.

The purely geological works and papers treating of the area under review are few. Firstly, there are the above-quoted volumes by Sturt, upon which Tenison-Woods, in his "Geological Observations in South Australia," 1862, has largely drawn for his disconnected account of the geological features of the Murray-river. My own efforts in this connection have been of a fragmentary kind, and will be found at the following references:—"Strata Exposed in the Government Well, Murray Plains," Geological Magazine, November, 1877; "Correlation of the Coral-bearing Strata in South Australia," Trans. Roy. Soc. S. Aust., vol. I., 1878; "Correlation of the Older Tertiary deposits of South Australia," id. vol. II., pp. li.-

* Two Expeditions into the Interior of Southern Australia; 2 vols. 1834.

Digitized by Google

lviii., 1879; and "Geological Sections around north-east shore of Lake Alexandrina," id. vol. IV., p. 144, 1881.

The literature of the palæontology of the Tertiary deposits of the Lower Murray-river is more extensive than that of its geology, and will be referred to when I come to speak on that part of my subject.

My personal knowledge of the Lower Murray-river is the result of several weeks' sojourn in each year during the last eight years at various points of its course from the North-west Bend to its mouth. That part of the river from the North-west Bend to the frontier was explored during a boat excursion occupying three weeks in the month of January of the present year.

Physical Features of the Murray-plateau.

If you approach the Murray from the westward, say in the latitude of Truro, you will see from the summit of the pass over the Belvidere Range, that the precipitous front of the Range, composed of Pre-Silurian rocks, bounds a vast sea of green without any sensible interruption so far as the eye can reach. You are looking down on the "mallee scrub" or desert of the Murray, the chief constituents of which are several species of Eucalyptus, notably *E. dumosa*, *E. uncinata*, and *E. oleosa*. "The trees grow close together like reeds, and certainly not thicker, without a branch, until about fourteen feet from the ground, and so dense are they, that ten and twelve stems may be counted springing from one root, and occupy little more than a square foot of ground. Where a road has been cut through it, it appears as though there were a high wall on each side." *

By a rapid descent from the Range we reach, at an elevation of about 400 feet above sea level, the edge of the talus, which stretches out on to the plateau for a distance of about sixteen miles. Here begins the true Murray plateau, with its outcroppings of limestone, and though its surface is somewhat undulating yet it preserves a pretty uniform level of not perhaps more than 200 feet elevation throughout its whole breadth, which extends far beyond the confines of this colony. At the southward this plateau ends in an ill-defined escarpment at Wellington, where the river discharges itself into Lake Alexandrina.

This extensive plateau is interrupted by the gorge of the Murray-river, for it cannot be called a valley, since it is enclosed by lofty continuous cliffs, appearing as if the plateau had been rent asunder to allow of a passage for its waters; the river occupies, however, a very small part of the bed of the gorge.

* T. Woods, "Geol. Observ.," p. 84.

Digitized by Google

The country through which the Murray flows from the boundary of the colony to Lake Alexandrina is essentially the same; and as the gorge-like feature persists throughout, it might be thought because of this uniformity that the geological structure is identical from end to end, but it is not so.

From structural and physiographic features I divide the course of the South Australian portion of the river into three sections:—

1. From the boundary to Overland Corner. This length of the river is 143 miles, whilst the distance between the two places is only 60 miles. The width of the gorge varies from six to two and a half miles.

2. From Overland Corner to Lake Alexandrina. At the former locality the gorge suddenly contracts to a width of about one mile; and as far as the North-west Bend the average width is one mile and a quarter, whilst south hence to below Blanchetown, it is three-quarters of a mile. Here and there it opens out to greater width as at Mannum, but is again contracted at its southern end.

3. The Lacustrine section from Wellington to its mouth.

[Mr. Pollitzer divides the river from Blanchetown according to his estimate of the rock nature of the cliffs into four sections:—1. Blanchetown to the North-west Bend, limestone. 2. North-west Bend to Overland Corner, partly limestone and partly sandstone. 3. Overland Corner to the Great South Bend, and 4. Thence to the Boundary. The third and fourth, "sandstone in various shapes, and clay."]

The cliffs of the upper section of the river are composed chiefly of sand, whilst those of the lower section are marine calciferous sandstone, as long since observed by Sturt, who writes "a remarkable change in the geology of the country, as well as to an apparent alteration in the natural productions—the cliffs of sand and clay ceased, and were succeeded by a fossil formation" (*loc. cit.*, II., p. 139). Indeed, as I shall hereafter explain, we have at Overland Corner—the locality indicated by Sturt in the foregoing quotation—the junction of two sets of unconformable beds.

Hydrographical Notes.

On the accompanying map (pl. III., fig. 1) the unshaded portion indicates a depressed area within the cliffs sufficiently low to be inundated by high floods; in the upper section of the river this is relatively of great extent, and is closely reticulated with creeks and lagoons; in the lower section the river sweeps along a line of cliffs, having on the other side an alluvial bank beyond which is a more depressed area occupied by a lagoon

Digitized by Google

stretching to the foot of the opposite cliff. (See pl. III., fig. 2).

The extent of the flood-waters is marked by the presence of the "box" or "swamp gum-tree" (*Eucalyptus largiflorens*); it and the red gum-tree (*E. rostrata*) are the only species of the genus inhabiting the alluvial tracts. The latter grows about the permanent water; whilst its congener prefers drier ground, though it is evident that its seeds require longish immersion in water to effect germination. *E. largiflorens* attains a maximum height of about 100 feet where growing in spots annually flooded; but depauperated specimens may here and there be seen considerably beyond the limits of the greatest flood on record, which seems to demonstrate that at no distant date still higher floods have occurred than we know of. This fact is so well-known on the river that no permanent habitation of any value is erected within the zone of the "box."

Mr. Pollitzer has shown by table the fluctuations of the water-level at Overland Corner during the last five years, from which we gather the highest elevation above zero of the Overland Corner gauge, for each year, to be as follows:—1879, 18 feet in December; 1880, 18 feet in January; 1881, 10 feet in January; 1882, 10 feet in November; 1883, 9 feet in January. The river is at a minimum level varying from March to May, begins to rise with the winter rains in June, and has the largest volume by the melting of snow in the summer months of December and January. The volume of water is largely dependent on these two sources, and an intermittent supply is furnished by the Darling. The tropical rainfall, which comes usually in February and March, and partially so in December, sets the Darling in flood. The flood-waters of the Darling reach the Murray after an interval of four weeks, the average velocity being about 50 miles per day. The volume of water in the Darling is at other times insignificant. If the tropical rains of December be heavy, and should the winter at the sources of the Murray be protracted, then the united flood-waters of the two rivers deluge the whole country within the gorge of the Lower Murray—these exceptionally high floods occur only at long intervals of time.

In the upper section of the river the flood-waters have a great area over which to spread themselves, whilst within the narrow gorge of the lower section the volume of water is compressed, and in consequence the maximum heights of the flood are here very much greater than they are in the upper section. The highest flood-marks at Morgan are 36 feet above summer water-level.

The much-discussed question of how to improve the navigability of the Murray raises several subsidiary ones, the im-

Digitized by Google

portance of which has been either overlooked or ignored. If the river were an equally discharging one, some earnest consideration might be given to the suggestions made by Mr. Pollitzer and in part entertained by the Government, viz., that of shortening the river-way by canals and by narrowing the width of the old river-bed. Of course an actual obstruction to navigation is presented by snags and a few rocky bars, which should be removed. But considering the very intermittent flow, our object should be rather to impound the waters than to seek by reduction of length of waterway to run them off at three, four, or more times their present velocity. Another question involved, and one which touches vested interests, is what effect would the proposed scheme have upon the periodic flooding of the alluvial flats. The effect would simply be to render unavailable for summer pasturage a vast extent of country, which now by natural irrigation secures to the grazier feed at a time when the upland country is totally unable to support his stock.

Mr. Pollitzer has pointed out among other defects of the river "the feeding of dead branches. Happily they are scarce on the Murray. There are innumerable creeks fed by the Murray, but only by its high water; at low almost all of them are dry." No doubt the vast reticulation of creeks and lagoons of the upper section of the river, filled when the river is in flood, is actually a reservoir which by discharging into the river as the water falls, helps to maintain a larger volume of flow than would be otherwise possible. But with respect to the bifurcation of the river by islands the case is different, as thereby the area is increased at the expense of depth of water. In the case of Craigie's Creek, which is the most prominent among the by-channels of the Murray, the defect may be overcome at comparatively trifling cost by simply damming it at the incurrent end, which interrupts a nearly straight line of river bank, and is, moreover, only a few yards across.

The water of the Murray is always thick with suspended matter, its white opacity increasing with the rise of the river. After flood the water of the lagoons and creeks has become clear, and its discharge into the river when falling materially helps to diminish its muddiness. This discharge, taking place during the summer months, is doubtless the chief source of the large quantity of organic matter dissolved in the water. A jar of muddy water taken at this time will, if freely exposed, become offensive before it has become clear. The lagoons and creeks are teeming with animal and vegetable life. The falling water is marked by the putrescent remains of animals and bleached masses of vegetable matter. Dying and dead snails of species of *Lymnæa* and *Bulinus* crowd in myriads the de-

Digitized by Google

pressions on the dessicating muddy flats. The water moved by the wind laves the shore and contaminates itself with its own rejectamenta.

One property of the water of the Murray is the remarkably low quantity of saline matter in solution, and its softness. Water collected in January in a fast falling river yielded at the rate of seven grains of dissolved earthy matter per gallon, whilst the quantity of calcic carbonate was 3·9 grains only per gallon.

River Alluvium.

It has been stated that the river occupies only a small part of the gorge, the rest being an alluvial deposit. The alluvium of the banks consists largely of fine sand mixed with fine clay in sufficient amount that when the whole is moistened to admit of being shaped into a cohering mass; when dry, however, the whole is perfectly incoherent. In the more inward-lying parts of the alluvial tract more clay has accumulated. The materials of the cliffs have not contributed, except in a partial way, to the formation of the alluvium; conspicuous among the constituents of the alluvium are spangles of white mica, which clearly indicate transport from a distance, as that mineral is not present in the cliffs of the Murray until an inlier of mica slate, fourteen miles north of Mannum, is reached; a distance of more than 300 miles from the Boundary.

Mr. Pollitzer insists that the alluvium "actually is a marine deposit" (p. 10). Whether his hypothesis, "that the gorge was made by a salt-water stream formed by the receding sea," demanded a marine deposit, or whether it was an inference based on the fact "that if you bore a hole in these deposits you will meet with brackish water, in spite of having fresh Murray water within a few inches," I cannot say; but it is most certainly true that Mr. Pollitzer has ignored the evidences of its fresh-water origin in the form of numerous shells still living in the river and its lagoons, whilst the existence of brackish water in the deposit admits of other explanation. In fig. 2, plate III., which represents a cross section of the gorge, I show that the debris of the cliff adjacent to the lagoon is interstratified with a clayey alluvium. The bed of talus, which is composed of sand and angular pieces of stone, admits freely the passage of water, whilst the contiguous clays confine it within that stratum. The water in the taluses is derived from the surface flow down the cliff-face, and in its passage takes up salt from the calciferous sand-rock. As some evidence of the appreciable quantity of the sodic chloride in the calciferous sand-rock, I have to state that the steep face of the cliff occupied by that rock is where protected by an overhanging ledge

Digitized by Google

covered by a sheet of hard brittle material of an eighth to one-fourth inch thick, constituted of the disintegrated calciferous sand cemented by common salt. An analysis of 40 grains dried at 100° C. yielded 16·28 grains of common salt extracted by distilled water and weighed after heating to redness. A portion of the calciferous sand-rock, taken from beyond a few inches of the surface, yielded the following:—

Salts extracted by boiling water	0·4
Salts dissolved by hydrochloric acid* ...	11·1
Insoluble residue	88·5
	100·0

It is, therefore, no longer a matter for wonder that the pent-up waters within the alluvium are brackish.

In no instance in the lower section of the river do the walls of the gorge approach so closely as to confine the river, and very rarely are the alluvial flats in opposition, the rule being that the river flows along one side of the gorge for a more or less straight course of varying lengths, whence it gradually curves inward, and finally impinges on the opposite wall; so that cliff and alluvium confine the river alternately on the one side, and alluvium and cliff on the other.

The course of the river is not so circuitous in this section as it is in the upper, where the river for long distances meanders through the alluvium; and here the course of the river is undergoing rapid change. The concave bank is continually being worked upon by the falling waters, whilst considerable deposition takes place on the corresponding convex-face. In some instances the periodic extension of the alluvium is distinctly marked by lines of red gum trees, graduating from saplings near the water's edge to full grown trees at several chains inward.

Origin of the Gorge of the River.

I think it will be conceded by all who have thoughtfully examined the rocky walls between which the river flows that they were once continuous, and that their separation is the result of the wearing action of the river itself. I am also of opinion that the gorge from Overland Corner to Wellington was at one time occupied by a stream covering its whole breadth. The irregularities of the gorge might be explained by the contour of the original surface and the varying degree of hardness of its rocky material rather than by the variability of the rock structure at present water-level, though the latter circumstance might have operated to form the minor sinuosi-

* Determined by difference.

Digitized by Google

ties of the gorge. The plateau of the Older Tertiary rocks in which the gorge of the lower section of the river has been formed ends in a comparatively lofty escarpment at Overland Corner, which Captain Sturt estimated at 200 to 300 feet. This was an over-estimate for the cliffs, though it might be correct for the plateau. The cliffs are, however, higher there than anywhere else on the river. What is the line of the escarpment back from the river I do not know, but abutting against that escarpment are beds of Newer Tertiary age, formed chiefly of loose material, constituting a plateau the mean elevation of which is below that of the escarpment at Overland Corner.

The materials of the minor plateau are of fresh-water origin —at any rate, no palæontological evidences have been adduced for or against—whilst the extreme angularity of the sand constituents and their false bedded arrangement demonstrate rapid accumulation such as takes place where torrential streams debouch into lake basins. We may apply here Sir A. C. Ramsay's opinion to the determination of the physical conditions under which the formation was deposited. He has stated* that the red colour which stains the Keuper Sandstone and Marl is due to the presence of peroxide of iron, which he believes to have been precipitated from carbonate, and which could only have taken place in inland isolated waters; an opinion that is confirmed by other facts which tend to prove that the rocks in question were formed in a lake or lakes. This belief he afterwards† extended to formations of older date.

The sharp sands, which form a considerable part of the material of the cliffs of the upper section of the river, not only vary in size, but also in colour, some portions being quite colourless, whilst others are deeply stained with red, and in several instances the oxide of iron has compacted the material into a firm grit-stone. In all cases the red colour of the sands or grits is superficial, as by treatment with hydrochloric acid it is totally discharged. Here, then, we have non-fossiliferous sands, highly stained with hydrated oxide of iron, whilst the other physical conditions under which they were accumulated all tend to confirm the view that they were formed in inland waters, and not in an open sea. However, this much is certain, that since the elevation of the Older Tertiary sea-bed to form the Murray Plain, some portions beyond Overland Corner have been denuded, and that a considerable depth and vast quantity of sands and loam have been deposited against the escarpment

* Quart. Journ. Geol. Soc., vol. xxviii., pp. 189, 1871.

† Op. cit., p. 241.

Digitized by Google

by the action of fresh water. To allow of such an accumulation the water must have been impounded by that escarpment. The surplus water would escape at the lowest level, and follow the trend of the ground—deflected at intervals by obstructions—and would discharge itself over the littoral escarpment near Wellington. Thus while the river was reducing its bed to an uniform slope throughout its length from Overland Corner, it would at its effluent end be cutting its way back. Probably, because of the soft nature of the material forming the channel, the rate of excavation by the moving water has been greater than that at the falls; however, by their united action there has been formed the mighty gorge. As the level of the impounded waters fell below the upper level of their sediments, so they would be eroded by the current thus established, and initiate the gorge of the upper section of the river. Finally, the whole gorge is excavated to its present depth, and a uniform slope of the river bed being formed erosion has ceased. As the volume of water in the bed decreased, so its shallow parts became silted up and finally dry, except when floods occurred and deposited fresh sediments upon the flats.

My theory may seem at first sight so startling as to place it beyond the pale of acceptance, as it involves the existence of a vast lacustrine area and a river of far greater volume than is at present, and this implies a correspondingly increased rainfall if the drainage area were the same then as now, which may be taken for granted. There are many independent evidences existing that this continent has passed through a period when its rainfall was greatly in excess, and was perhaps augmented by glacial conditions. The storage capacity for water of our lake basins in the dry zone of Central Australia is vastly superior to their present condition. Lake Eyre, for instance, its margin is 40 feet below sea-level, whereas if filled its depth would be increased by not less than a hundred feet, and its area enlarged many times. And yet there is evidence that at one time it was a vast expanse of water, and the vegetation in its vicinity capable to sustain life in such huge creatures as the Diprotodons, whose remains are scattered widely in and around its basin; a country in its present state abandoned, even by the kangaroo. As I have elsewhere* pointed out, the existence of those gigantic herbivorous marsupials in such localities demands climatic conditions favourable to the growth of a vegetation capable of supporting them, and that their extinction is attributable to those climatic changes which brought about dessication, involving a reduction in volume of the waters of inland lakes, and finally converting their basins into salt-pans.

* Trans. Roy. Soc., S. Aust., vol. ii., p. lxvii., 1879.

Digitized by Google

Though there is no palæontological evidence by which to correlate the sands and loams forming the cliffs of the upper section of the Lower Murray River with the Drifts characterised by the Pliocene marsupials; yet the physical conditions under which each seem to have been accumulated point to contemporaneity.

Sections of the Older Tertiary Deposits of the Lower Section of the River.

In a paper Notes on the "Correlation of the Coral-bearing strata of South Australia,"* I presented a generalized section of the strata in the cliffs of the River Murray, in which the following subdivisions in descending were adopted:—Lacustrine, Upper (Marine) Murravian, Middle (Marine) Murravian, and Lower (Marine) Murravian. In the following year, in my presidential address, "Outlines of South Australian Geology,"† these views are repeated, and are accompanied by a numerical statement as regards the community of species between the Upper Murravian and the Muddy Creek deposits. Further studies at the section which supplied the chief material for the comparison have convinced me that my Upper Murravian should be restricted to the oyster banks,‡ and that the underlying beds, rich in gastropods, merge into the main mass of the Middle Murravian. This re-arrangement, which places the Muddy Creek beds on the horizon of the Middle Murravian, does not materially affect the deductions drawn from my survey of the census of the fauna at each of the two localities.

I may best describe the strata of the Older Tertiary cliffs by means of an illustrative

Section taken near Glenforslan, four miles north from Blanchetown.

		ft.	in.
	Lacustrine.		
1.	Travertine cover and thin-bedded sandy limestone	7	5
2.	Red and blue clay	5	7
3.	Compact earthy argillaceous limestone	5	3
4.	Friable sandstone, with occasional layers of coarse sand	5	5
	Upper Murravian.		
5.	Oyster-bank	0	10
6.	Friable sandstone, with fragments of shells and cidaris	8	9
7.	Oyster-bank	2	6
8.	Red and yellow clayey sand, with scattered oysters	2	4

* Trans. Roy. Soc. S. Aust., vol. I., p. 120; 1878.
† Op. cit., vol. II., p. liii.; 1879.
‡ Poste p.

Digitized by Google

Middle Murravian.

	ft.	in.
9. Dense mass of *Cellepora Gambieriensis* in a reddish calcareous paste; a few oysters and fish teeth	2	0
10. White friable earthy limestone, stained atop with iron; phosphatic concretions. Highly charged with *Waldheimia Macleani*, and casts of molluscs in gypsum	4	4
11. Yellow limestone, with *Toricula Murrayana* in gypsum	0	6
12. Light grey calciferous sandstone, with a thick bank of *Cellepora Gambieriensis*	6	0
13. Id. with banks of *Cellepora Gambieriensis*... ...	43	4

Lower Murravian.

14. Hard grey calciferous sandstone, with *Lovenia Forbesi*, *Cellepora Gambieriensis*, *Nautilus* sp. in gypsum...	1	4
15. Brown friable calciferous sandstone, weathering with a rough exterior	2	8
16. Hard grey calciferous sandstone, with casts of *Torcula Murrayana*	0	7
17. Brown friable calciferous sandstone	3	0
18. As No. 16	0	10
19. As Nos. 17 and 15, *Panopæa* sp.	1	6
20. As No. 18	1	5
21. Yellow-grey friable calciferous sandstone, with casts of *Torcula* in gypsum	14	8
Total to river level	120	3

From Overland Corner to south of Blanchetown, the beds show decided undulations particularly noticeable in those of the Lower Series, the brown hard sandstones of which acquire locally enlarged proportions. To the eastward of the North-West-Bend the calciferous sand-rock shows local attenuations and the Upper Murravian is proportionally thickened (see North-West-Bend Section). Hence the dip is referable to variations in the thicknesses of the several beds, for if we note the levels for a long line of cliffs, it will be found that the beds have no general inclination.

SECTION AT NORTH-WEST-BEND HEAD STATION.

Lacustrine.

	ft.	in.
1. Sand		
2. Marly clay, with travertine cover (1½")	3	8½

Digitized by Google

Upper Murravian.

	ft.	in.
3. Hard sandstone	2	0
4. Soft sandstone, false-bedded	8	2
5. Oyster-bank—a dense mass of shells in a calcareous paste. Oysters, pearl-shells, *Trigonia acuticosta*, &c., and casts of univalves	8	0
6. Sand-rocks unfossiliferous	10	0

Middle Murravian.

7. Yellowish-grey calcareo-argillaceous sand-rock with hardish bands of *Cellepora Gambieriensis*. Polyzoa abundant, numerous palliobranchs and echinoderms.	42	10
Total to river level	74	8½

Going eastward, the oyster-bed thickens and at a mile from the Station the section consists of about 40 feet of oysters and 20 feet of yellow calciferous sand-rock.

SECTION AT FOUR MILES SOUTH FROM MORGAN.

Lacustrine.

	ft.	in.
1. Reddish-coloured calciferous clays	54	0

Upper Murravian.

2. Oyster bank	12	0

Middle Murravian.

3. Hard, lumpy, yellow sandstone	10	0
4. Yellowish-grey limestone with clayey-sand layers	10	10
5. Yellowish-brown clayey-sand with *Cellepora Gambieriensis*	5	4
6. Id. with hard lumps and imperfectly stony bands. Very fossiliferous, particularly rich in gastropods	16	5
7. Shell sand with streak of stiff blue clay	0	3
8. As No. 6	5	0
9. Yellow soft calciferous sandstone	43	6
Total to river level	157	4

PALÆONTOLOGY OF THE OLDER TERTIARY DEPOSITS.

Bibliography.—So far as known to me, the following is a brief digest of previous writings in connection with Murravian fossils.

The earliest reference to the existence of fossils in the

Digitized by Google

Murray cliffs is by Captain Sturt, who collected on his voyage down the river, some of which are figured in the account of his exploration.* In an appendix, pp. 253 and 254, the author gives a list of the fossils collected from this formation, embracing Polyzoa, 8; Echinoderms, 3; Lamellibranchs, 16; Palliobranch, 1; Gastropods, 14. Most of those of the first three classes are referred to by specific names employed for European tertiary fossils. Of those figured a shrewd guess can be made at the species referred to, but in no case can Captain Sturt's determination be accepted.

As giving a better insight into the present state of our knowledge of the palæontology of the formation, I arrange the subject matter of this progress report according to zoological classification.

CLASS MAMMALIA.

Zeuglodon Harwoodii, Sanger, is figured and described in Proc. Lin. Soc., N.S.W., vol. 5, p. 298, 1880. Remains of this interesting and aberrant cetacean were obtained near Wellington.

CLASS GASTROPODA.

Marginella Wentworthi, Tenison Woods, and *M. propinqua*, Tate, are recorded in my "Fossil Marginellidæ of Australasia," Trans. Roy. Soc., S. Aust., vol. i., pp. 92 and 94, 1878. *Cassis textilis* and *Fissurellidæa malleata* are described id. vol. v., pp. 45, 46; and *Torcula Murrayana* and *Leiostraca Johnstoniana* in Proc. Roy. Soc., Tasm., 1884.

CLASS LAMELLIBRANCHIATA.

Trigonia acuticostata is recorded by Bednall, Trans. Roy. Soc., S. Aust., vol. i., p. 82, 1878. *Zenatiopsis angustata*,, gen. et spec. nov., and *Lepton crassum* are described in vol. ii. of the same Proceedings, pp. 129 and 130; and *Corbula ephamilla*, *Chione dimorphophylla* and *Lima Jeffreysiana* in Proc. Roy. Soc., Tasm., 1884.

CLASS PALLIOBRANCHIATA.

Waldheimia Taylori, Etheridge, is figured and described in Annals and Mag. Nat. Hist., January, 1876; and in my monograph of the Tertiary Palliobranchs of Australia (Trans. Roy. Soc. S. Aust., vol. iii., pp. 140—17, plates vii. to xi., 1880) the following are described and recorded:—*Terebratula vitreoides*, Woods; *Waldheimia Garibaldiana*, Davidson; *W. divaricata*, Tate; *W. Tateana*, Woods; *W. grandis*, Woods; *W. Macleani*, Tate; *W. Coriœnsis*, McCoy; *Terebratulina Scoulari*, Tate;

* Two Expeditions into the Interior of Southern Australia, 1834, vol. ii., plates 2 et 3.

Digitized by Google

T. Davidsoni, Etheridge; *Magasella compta*, Sowerby; *M. Woodsiana*, Tate; and *Rhynchonella squamosa*, Hutton.

CLASS POLYZOA.

The Rev. J. E. Tenison Woods, in Trans. Roy. Soc., Victoria, vol. vi., applied new names to some of the forms figured by Sturt, but these have been ignored by Mr. Waters in his several papers dealing with this class in the Older Tertiary of Australia.

Mr. Woods has, moreover described and figured from the Murravian deposits, the following *Selenariadæ*:—*Cupularia rutella* and *Selenaria alata*. Trans. Roy. Soc., S. Aust., vol. iii., 1880.

Mr. Waters has recently occupied himself with the determination of the Cyclostamatous and Chilostomatous species occurring in the River Murray cliffs from material furnished by me. His paper will appear in a forthcoming number of the Proceedings of the Geological Society of London; in the meanwhile an approximate summary of his results, as communicated by letter to me, is given at p. 18.

CLASS CRUSTACEA.

Prof. G. Brady furnishes a list of four species of Ostracoda obtained from the Government Well between the Burra and North-West Bend (Geological Magazine, July, 1876). The species are *Bairdia ovata*, G. B.; *Macrocypris acuminata*, Reuss; *Cythere Normani*, G. B.; and *Paracypris decora*, G. B.

CLASS ECHINODERMATA.

Dr. Laube ("Ueber einige fossile Echiniden von den Murray Cliffs" in Sitz. d. k. Akad. d. Wissench., Wien, 1869) describes and figures, as new, eight species, viz., *Echinus Woodsii* (Psammechinus), *Temnechinus novus* (Paradoxechinus), *Micraster brevistella*, *Arachnoides australis* (Monostychia), *Catopygus elegans*, *Echinolampas ovulum* (= *E. Gambieriensis*, Woods), *Eupatagus Murrayensis*, *E. Wrightii*, and records *Lovenia Forbesii*.

Professor Dr. Duncan, in Quart. Journ. Geol. Soc., vol. xxxiii., p. 44 et seq., 1877, adds as new species *Eupatagus rotundus* and *Megalaster compressus*.

CLASS ACTINOZOA.

The coral fauna of the Murray Cliffs has been catalogued by me in the first volume of our Transactions. It comprises seven species, one of which, *Deltocyathus alatus*, was described and figured as new by Tenison Woods in the same volume. The other species are *D. viola*, *Sphenotrochus australis*, *Flabellum*

Digitized by Google

Victoriæ, *Placotrochus deltoideus*, *Antillia lens*, and *Balanophyllia australiensis*.

CLASS FORAMINIFERA.

Mr. H. B. Brady, in Geological Magazine for July, 1876, gives a list of 24 species determined by him from material obtained in sinking the Government Well between Burra and North-West Bend.

Summary of recorded species.

Mammalia	1
Gastropoda	6
Lamellibranchiata	6
Palliobranchiata	13
Polyzoa	39
Crustacea	4
Echinodermata	11
Actinozoa	7
Foraminifera	24
Total	111

The major part of the species upon which the above summary is based consists of those which have been described from the actual beds, whilst the rest has been included on good authority. Many more remain to be catalogued, as may be gathered by reference to a census of the fauna of the Gastropod-bed near Morgan submitted by me in the second volume of our Transactions, p. liv., 1878. Since that time gatherings have been repeatedly made, and the elaboration of the species has received some attention. Many species have been identified with those of the Mollusca described by Woods and McCoy, and of Echinoderms by Duncan; but a large proportion has yet to be named. However, the Lamellibranchs are in course of treatment by me after the plan adopted with regard to the Palliobranchs of the Older Tertiary of Australia, and I trust that before the lapse of many months the results will be before you. When the Gastropods shall have been similarly elaborated, it will then be possible to correlate the various fossiliferous beds, and to promulgate more decided opinions as to the relationship of the faunæ *inter se* and to those of other Tertiary areas and to recent ones.

In the lists of the characteristic species of the several subdivisions of the Murravian formation which follow I have included only those of which diagnoses have been published, many of which are for the first time recorded as Murravian fossils.

Digitized by Google

SPECIES OF UPPER MURRAVIAN.

The fauna of this subdivision is very meagre, and it is only at few spots where other than the ubiquitous oyster is found; and then, for the most part, the tests have more or less exfoliated, so that it is not always possible to refer them to their generic position. Besides the oyster there is a large *Margaritifera*, *Trigonia acuticostata*, McCoy, *Pectunculus laticostatus? Arca*, 2 spp., *Tellina*, *Mactra*, &c., *Clypeaster Gippslandicus*, McCoy.

SPECIES OF THE MIDDLE MURRAVIAN.

The soft calciferous sandstone which makes up the chief part of the sub-formation, and which maintains a uniform character from Overland Corner to many miles south of Blanchetown, is especially rich in members of the families Ostreidæ, Limidæ, Anomiadæ and Pectinidæ, in Palliobranchs, Polyzoa, and Echinoderms.

About Mannum the formation consists of red raggy limestones, full of *Lovenia Forbesii* throughout its whole thickness of about 150 feet, and of overlying coarse polyzoal rock of about 10 feet; in the latter *Catopygus elegans* occurs. The upper 40 or 50 feet contain the same assemblage of fossils as the Middle Murravian further north; and I incline to the opinion that the whole embraces both the Middle and Lower Series, but because of its lithological and, concurrently, palæontological uniformity they are here not separable.

Referring back to the 'Section at four miles south from Morgan,' the beds numbered five to eight inclusive deserve especial notice from the profusion of their fossils and from the circumstance that the habitat is unique so far as regards the cliffs. Here because of the slight admixture of argillaceous matter in the matrix, the tests of gastropods and of many bivalves have been well preserved, but this condition is maintained only for about 350 yards, measured along the front of the cliff, beyond that the shells gradually disappear with the diminution of clay, and finally at half-a-mile distant the beds have merged into the limestones, caverned with casts, and the ordinary calciferous rock. The absence of argillaceous matter in the marine beds forming the gorge of the river is remarkable; but at varying distances beyond, well-sinkings have revealed the occasional presence of clays, which are usually rich in fossils identical with those of beds 5 to 8 just treated of.

The blue marl in the following section yielded fossils of this character:—

Digitized by Google

GOVERNMENT WELL, BETWEEN BURRA AND NORTH-WEST-BEND.

	FT.
Red loamy clay (Pliocene)...	40
Light-coloured sandstone with casts of shells ...	10
Gravelly ironstone and layers of clay ... }	81
Blue marl ... ... }	
Sandstone without shells	17
Running sand	6
Total	154

Similar results were obtained in a well-sinking five miles east of the above, and at "nine-mile camp," near North-West Bend. Again, at Westbrook, about eleven miles north of Wellington and one and a-half east from the river, a blue marl occurs near the bottom of a well, sixty feet deep, charged with fossils in an excellent state of preservation.

Charcharodon angustidens, *Ag.*; Otodus Desori, *Ag.*; Lamna elegans, *Ag.*

Aturia australis, *McCoy.*

Typhis McCoyi, *Woods*; Triton Abbottii, *Woods*; Ranella Prattii, *Woods*; Nassa Tatei, *Woods*; Ancillaria semilævis, *Woods*; A. mucronata, *Sow.*; A. hebera, *Hutton* (*?*); Cassis textilis, *Tate*; Voluta Hannafordi, *McCoy*; V. antiscalaris, *McCoy*; V. strophodon, *McCoy*; Marginella Wentworthi, *Woods*; M. propinqua, *Tate*; Niso psila, *Woods*; Eulima acutispira, *Woods*; Leiostraca Johnstoni, *Tate*; Mangelia bidens, *Woods*; Daphnella gracillima, *Woods*; Triforis sulcata, T. Wilkinsoni, and T. planata, *Woods*; Cerithium cibarioides, *Woods*; Cypræa gigas, C. leptorhyncha, and C. consobrina, *McCoy*; Trivia avellanoides, *McCoy*; Conus Traillii, *Woods*; Cancellaria varicifera, *Woods*; Torcula Murrayana, *Tate*; Natica polita and N. Hamiltonensis, *Woods*; Solarium acutum, *Woods*; Minolia strigata, *Woods*; Liotia Roblini, *Johnston*; Cyclostrema acuticarinata, *Woods*; Xenophora undulata (?); Fissurellidæa malleata, *Tate*; Emarginula transenna, *Woods*; Cylichna exigua, *Woods*; Bulla scrobiculata, *Woods*; Pecten Yahliensis, P. Foulcheri, and P. incertus, *Woods*; P. Darwini, *Sow.*; P. Atkinsoni, *Johnston*; P. spondyloides, *Tate*; Lima Bassii, *Woods*; L. Jeffreysiana, *Tate*; Spondylus pseudoradula, *McCoy*; Leda inconspicua, *Woods*; Nucula tumida, *Woods*; N. Atkinsoni, *Johnston*; Limopsis Belcheri, Pectunculus laticostatus (?).

Cucullæa Coricensis, *McCoy*; Crasatella oblonga, *Woods*; Lepton crassum, *Tate*; Chama lamellifera, *Woods*; Cardium pseudomagnum, *McCoy*; Chione Cainozoica, *Woods*; C. dimorphophylla, *Tate*; Corbula ephamilla, *Tate.*

Digitized by Google

Rhynchonella squamosa, *Hutton;* Terebratulina Scoulari, *Tate;* T. Davidsoni, *Etheridge;* Magasella Woodsiana, *Tate;* Waldheimia Garibaldiana, *Davidson;* W. grandis, *Woods;* W. Taylori, *Etheridge;* W. Tateana, *Woods;* W. Macleani, *Tate;* W. divaricata, *Tate;* W. Coricensis, *McCoy;* Terebratula vitreoides, *Woods.*

All the Polyzoa enumerated by Mr. Waters.

Leiocidaris australis, *Duncan;* Echinus Woodsii, *Laube;* Temnechinus novus, *Laube;* Catopygus elegans, *Laube;* Micraster brevistella, *Laube;* Brissiopsis Archeri, *Woods;* Holaster australiæ, *Duncan;* Echinolampas Gambieriensis, *Woods;* Lovenia Forbesii, *Woods;* Eupatagus rotundus, *Duncan;* E. Murrayensis and E. Wrightii, *Laube;* Arachnoides australis, *Laube;* Megalaster compressus, *Duncan.*

Deltocyathus viola, *Duncan;* D. alatus, *Woods;* D. excisus, *Duncan;* Sphenotrochus australis, *Duncan;* Flabellum Victoriæ, Placotrochus deltoideus, Antillia lens, Balanophyllia Australiensis, *Duncan.*

The ostracods and foraminifera catalogued by the Messrs Brady.

SPECIES OF THE LOWER MURRAVIAN.

This series is characterized rather by lithological than palæontological characters, which latter are somewhat negative, as the species are few in number and somewhat sparsely distributed. It is often highly charged with gypsum, and then fossils are rarely present. Cetacean remains have occured to me only at this horizon, notably at MacBean's Pound, four miles from Blanchetown, whence I obtained the entire lower jaw of a balenoid whale, six feet long, and at Murbko, 14 miles north of Blanchetown, whence I extracted a cranium. The anterior half of a Paguroid-fish in excellent preservation was obtained at Morgan from these beds.

At Morundi, a few miles south from Blanchetown, this series is represented by a brown sandy calciferous rock of about 40 feet thick, distinctly bedded, with lines of echinoderms in the planes. Here *Lovenia Forbesii* and *Magasella Woodsiana* occur in great profusion; it is also the chief station for *Megalaster compressus.*

SECTIONS OF THE NEWER TERTIARY DEPOSITS OF THE UPPER SECTION OF THE RIVER.

1. *At the Boundary, 235 miles from Blanchetown.*—The cliff at the river margin is composed of about 20 feet of red loam, whilst back from the river coarse-grained sand-rock appears at a higher level.

Digitized by Google

2. *Section of cliff at* 226 *miles from Blanchetown :—*

Grey sand with thin layers of sand-rock, about	40 feet.
Sand-rock	2 to 3 ft.
Red sand	10 feet.
Total	52 feet.

The whole more or less false-bedded.

3. *At Murthoo,* 212 *miles from Blanchetown.*—The channel of the river is, here, contracted and shallowed by a reef of ferrous sand-rock, which forms the base of the cliff, whilst its main mass is composed of a white, coarse, false-bedded sand.

4. *At Spring-Cart Gully,* 164 *miles from Blanchetown.*—The cliff at this place is the highest on the upper section of the river, and consists chiefly of sharp sands, but has towards its upper part a thickly-bedded freestone, consisting of angular quartz grains cemented by amorphous felsitic matter. This stone, which is used as a building material, is comparable with some of the softer felsitic quartzose sandstones of Pre-Silurian age occuring in the Mount Lofty Range.

5. *Pyap Reach,* 123 *miles from Blanchetown :—*

Red and white clayey sand, sprinkled with mica-flakes, ...	about 10 feet
Red loamy clay	15 "

6. *Cliff at* 101 *miles from Blanchetown :—*

Reddish sands	about 10 feet
Dirty yellow or greenish sharp sands ..	10 "
Coarse quartzose sand-rock; grains sub-angular and coated with hydrated ferrous oxide...	15 "
Grey, angular, coarse sand	30 "
Hard calciferous sand-rock with a few Older Tertiary fossils	5 "
Total	70 "

This last section is instructive, as it is the only one known to me in which the actual superposition of the sharp fluviatile sands upon the marine beds is visible, though the same phenomenon may be inferred at Overland Corner. This section is distant in a straight line from Overland Corner four miles only, and yet in that short distance the whole character of the stratigraphy has changed, as at the latter place the very high cliffs consist of calciferous sandstone of marine origin, overlain by oyster banks, and these by blue clay. The evidence of the unconformability at Overland Corner is, I think, sufficiently clear, as on the western flank of the scarped cliff there appears at a little below the level of the oyster bank ferruginous

Digitized by Google

sand, which in the form of a minor escarpment skirts the river for a few miles to the eastward and sweeps round Lake Bonney, where the sand is white and exceedingly large in grain.

As to the areas occupied by the Newer and Older Tertiary deposits respectively, the information in my possession is too fragmentary to allow of an attempt at definition, though it may be useful to record it.

West side of the River Murray.—At the Half-way House, on the edge of the mallee scrub on the road to Blanchetown from Truro, a well-sinking commencing in red drift penetrated oyster banks at 110 feet from the surface.

The Government Well and other sinkings adjacent prove that the subter-structure of the Desert is Older Tertiary.

The most distant locality from the river at which Older Tertiary fossils have been obtained is in a well sinking at the north-east corner of County Burra, forty-seven miles due north from Morgan.

North side of the River Murray.—The following section indicates the northern extension of the Newer Tertiary.

Well-sinking at Oakvale, about ten miles due west from 74 milepost measured from the River Murray, on the boundary between South Australia and New South Wales (communicated by Mr. D. Cudmore) :—

At 175 feet, yellow ochreous clay.
At 180 " grey pipeclay.
At 190 " id.
At 196 " black clay, with much quartzose sand.

Doubtlessly the whole of the depressed area about the Lower Darling is constituted of Newer Tertiary.

South side of the River Murray.—The geological structure of the country which intervenes between the river at the Boundary and the Tatiara is, so far as I know, quite blank; but it is not unreasonable to suppose that the Newer Tertiary at these places is coterminous. The Tatiara is an oasis on the edge of the mallee scrub, in the one direction, and of the heath-lands of the South-East in the other; it owes its reputation to deep loamy soils, the upper members of an extensive lacustrine deposit, as is partly revealed by a well-sinking at Border Town, of which the following is a summary of the facts :—

Pipeclay	... ...	30 feet.
Diatomaceous earth	...	21 "
Bituminous shale and clay	...	40 "
Total	... ...	91 feet.

Digitized by Google

The Rev. Tenison-Woods* supplies an account of another sinking at Bingham Station, Tatiara; "the whole depth of 75 feet was occupied by beds of variegated sands of various thickness," the lower 10 feet consisting of sand and clay. According to the same geologist, the most northerly exposures of Older Tertiary are "on the upper part of the Red Cave Range near Broad Meadows, and at Kybobolite on the same range, but about nine miles north," op. cit., p. 18. The Older Tertiary occupies a comparatively small area in our South-Eastern district, in the form of a table land of an average elevation of about 200 feet, but inclining from south to north. From Kybobolite the escarpment passes south by way of the Cave Range, east of Narracoorte, to about six miles west of Penola, thence by Kalangadoo and Glencoe to its most westerly boundary at Mount Graham. The last place is also the western termination of the overlying volcanic masses of the Mount Burr Range. From the Mount Burr Range the outcrop approaches to within about sixteen miles west from Mount Gambier, thence to Port MacDonnell and the Glenelg River; much, however, of this portion of the country is covered by ash beds and recent marine deposits. The marine pleistocene deposits flank the Older Tertiary from the Glenelg to Cape Northumberland, and thence to Narracoorte; to the north of which older, though Newer Tertiary, deposits complete the isolation of the Mount Gambier beds.

Leading Botanical Features.

In this chapter I wish to set forth the leading floral characteristics of the Murray region, as they are sufficiently varied in relation to geological and hygrometric conditions to justify a short review. An enumeration of the species, about 650, constituting the flora is unnecessary, as that has already been made in my "Census of the Flora of South Australia" and "Supplements" thereto, published in the Transactions of the Society.

I. of the Gorge.

(*a*) *Fluviatile*:—Ranunculus aquatilis, Limnanthemum, two sp.; Hydrilla, Valisneria, Ottelia, Potamogeton, three sp.; Cyperaceæ, Panicum spinescens ("Water-grass"), Azolla, two sp.

(*b*) *Alluvium*:—Myosurus, Ranunculus parviflorus, var.; Eucalyptus rostrata ("Red-gum"), E. largiflorens ("Box"), Callistemon brachyandrus, Muhlenbeckia Cunninghami ("Polygnum-bush,") which forms dense belts around the lagoons, Abutilon Avicenniæ, Acacia stenophylla, Swainsonia Greyana ("Darling-pea"), Glycerrhiza psolaroides, various

* Rep. Geol. of the South-East, p. 13; 1866.

Digitized by Google

species of Salsolaceæ, notably Atriplex nummularium ("Cabbage salt-bush"), A. semibaccatum and Bassia salsuginosa, Epaltes australis, Senecio Cunninghami, Helichrysum lucidum, Exocarpos stricta, Limosella aquatica, Glossostigma, Gratiola, two sp., Stemodia Morgania, Eremophila divaricata, Cyperaceæ, species of Panicum, Andropogon, Eragrostis, &c., Marsilea quadrifolia.

(c) Cliffs at the water line:—Swainsonia Greyana, Wahlenbergia, Aspidium molle, also stragglers from the alluvial tracts.

Some of the above-named species are more or less restricted to one or the other section of the river, thus:—

LOWER SECTION.	UPPER SECTION.
Limnanthemum exaltatum	Glycyrrhiza psolaroides
Gratiola Peruviana	L. crenatum
Aspidium molle	G. pedunculata
Azolla rubra	Ottelia ovalifolia
	A. pinnata

II. TABLE LAND OR MURRAY DESERT OF THE LOWER SECTION.

On the western side of the river, as far north as Morgan, the surface of the plateau is more or less stony (rubbly travertine) and covered with mallee scrub; but on the eastern and northern sides the oyster banks are succeeded by clays, and these at higher levels by sands. In accordance with these different petrological features so the prevailing floral characters vary. The greatest number of species occurs along the trail of the sand over the underlying clays as might be expected from hygrometric conditions; here, also, exist the "native wells."

(a) Stony Surfaces.—The constituents of the "mallee scrub," in the open parts of which prevail *Casuarina suberosa*, many shrubby Asters, Acacias, Cassias, Templetonia egena, and Grevillea Huegelii; and during early spring many humble annuals appear in considerable profusion, such as Alyssum, Erysimum, composites, Goodenias, Bromus arenarius.

(b) Clay Surfaces.—The mallee scrub of the stony surfaces is interspersed with glades, which occupy clay depressions on which water remains for some time after heavy rains. Here the mallee does not grow, from which we may infer that its seed cannot withstand prolonged immersion in water. This is, however, the favourite habitat of *Myoporum playtycarpum*, so-called "sandal wood." The vegetation on the lacustrine clays is the same as that of the glades, and its chief constituents are the better kinds of fodder plants, Rhagodias, Kochias, Lycium, Dodonæa spp., Tetragonia expansa.

Digitized by Google

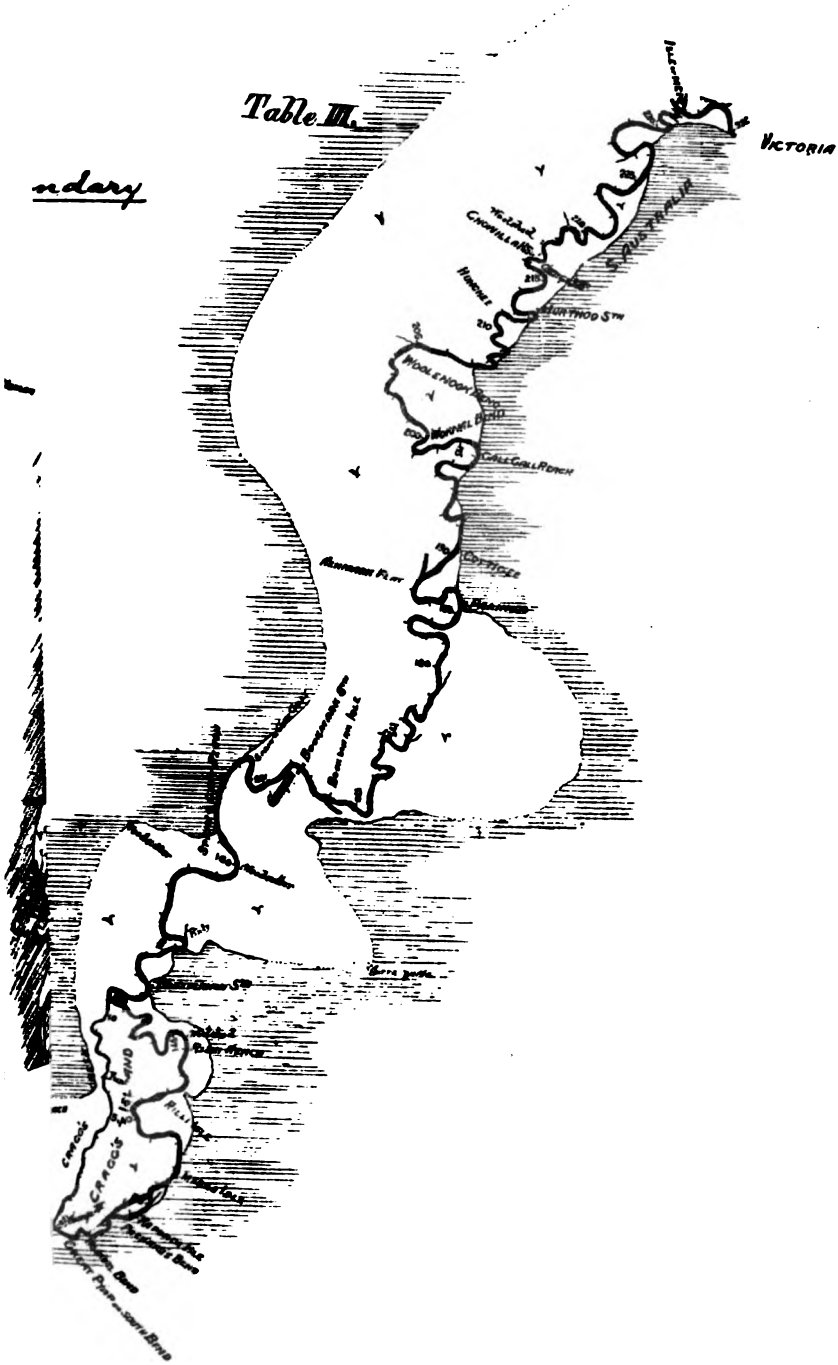
(*c*) *Sand Surfaces.*—Here, again, we have mallee scrub, with an undergrowth of the *Festuca irritans* ("Porcupine-grass" or spinifex), Asters, and Zygophyllum, spp.; and where the sand is not too deep forests of *Callitris verrucosa* prevail. On the edge of the sand ridges a profusion of herbaceous species grow after copious rains, including several Swainsonias, Myriocephalus Stuartii, Helipterum polygalifolium, H. moschatum, Crinum pedunculatum, Ophioglossum vulgatum.

Explanations to Plate III.

Fig. 1. Sketch-map of the Geology about the Gorge of the River Murray from the Boundary to Blanchetown (based on Mr. Pollitzer's chart).

Fig. 2. Diagrammatic Section across the Gorge of the Lower Section of the River.

Digitized by Google



Digitized by Google

Digitized by Google

A Rare and Curious Hemipterous Insect.

By J. G. O. Tepper, F.L.S., Corr. Memb.

[Read November 6, 1888.]

Figures 1 and 2, Plate IIIa.

A small though very curious insect was lately obtained by me in the hills near Adelaide. It belongs to the Heteroptera, sub-division Hemiptera, is related to the family of Berytidæ, and resembles somewhat the English species *Neides depressum*, and also some of the Hydromeridæ, or water-bugs, especially the genus *Ranatra* in its excessively thin and long limbs.

The body is linear in outline, and five-sixteenths of an inch long; its greatest width—a little posterior to the middle of the abdomen—is one-thirty-second of an inch, the remainder varying between this width and less than the one-sixty-fourth of an inch immediately behind the eyes. Its general colour is ashy brown above, with part of the prothorax and the legs rufus; below it is very dark brown.

The head is conical, ending in a proboscis which is slightly curved forward and downward, and is twice as long as the head, the latter being two-thirds of the length of the prothorax, and the two conjointly are about one-third of that of the remaining part. The proboscis consists apparently of an elastic bristle in a sheath opening with a slit upwards, and has four joints, admitting alternate flexure up and down, the last joint being black.

The eyes are lateral, oval, slightly projecting, and have a small protuberance or horn between them. Before them, but closer together, the long clubbed antennæ are inserted upon a blunt conical base. They consist apparently of seven joints. The first or basal joint is short and several times the diameter of the remainder, which is extremely slender, *i.e.*, about one-half of the thickness of a fine human hair, but nearly equalling in length that of the whole body. The second joint is the longest, forming nearly one-half of the whole, its anterior extremity suddenly expanding into a short cylindrical club, which is darker in colour than the rest. The third and fourth joints are of equal length, and together about two-thirds of the second, both slightly widening at the anterior joints, these being also dark in tint. The three or four last joints form an ovate club, the two middle ones being the thickest, black, and equal in diameter to the club at the end of the second. The

Digitized by Google

prothorax is sub-conic-pyramidal, widest behind; its posterior upper angles formed by short spines. But little curved above, it is slightly rough and the medium line distinctly raised. The mesothorax and metathorax are very short, together not equalling the prothorax, and greatly compressed from above. The abdomen is long, flatly compressed, with distinct margin and nine joints, the terminal two being the smallest.

The legs are extremely long and slender—scarcely, if at all, thicker than the antennæ. The first pair are the shortest, the last the longest, and the middle intermediate in length, being all equal in thickness. The outer extremity of the femur forms a club similar to that of the second joint of the antennæ, but much larger; the corresponding end of the tibia widens but slightly and is, as well as the clubs, dark brown. The tarsi are formed of three short joints, semicircular, and a short sharp claw. Two specimens only (one imperfect) were obtained by shaking low trees of *Eucalyptus obliqua*, or stringybark, not in flower. It is evidently carnivorous, and, as shown by its structure, must have habits analogous to those of the Mantidæ, its long thin legs indicating that its prey, though weak, must be quick and active. The wings are perfect, though somewhat short, allowing one-half the larger, beside the terminal, joint of the abdomen to project, and exhibit rather strong ribs, denoting vigorous power of flight.

A Beautiful and Rare Beetle.

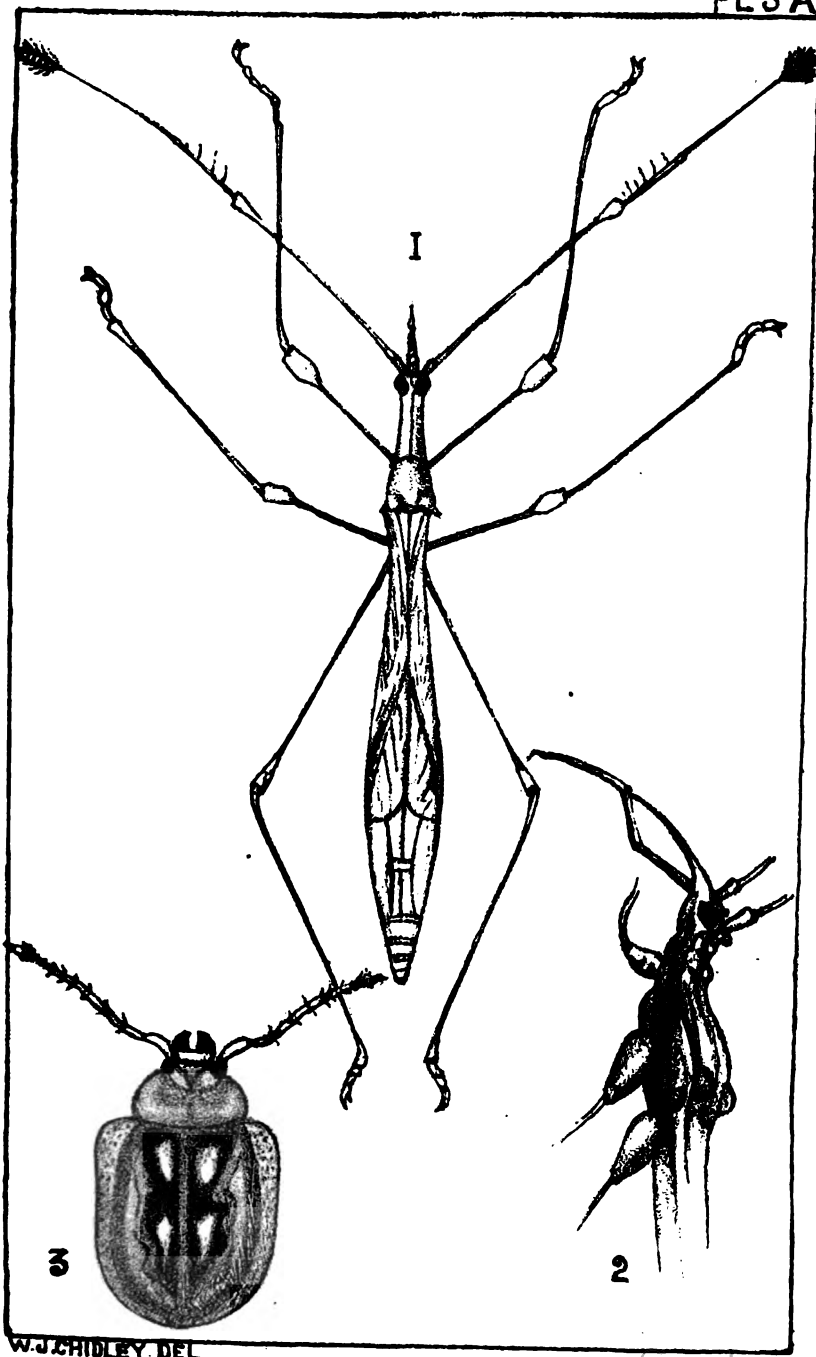
By J. G. O. Tepper, F.L.S., Corr. Memb.

[Read November 6, 1883.]

Plate IIIa. Fig. 3.

The insect to be described, enlarged six diameters, is rather rare; it feeds upon the leaves of some *Eucalypti*, as *E. odoratus* and *E. obliqua*, &c., found in the hill districts. The specimen under review was obtained near Mount Lofty, but the same species had been previously captured in the Barossa Ranges. Its season of occurrence, in the perfect state, extends from the early part of October into the summer months, but nothing has been observed about its metamorphoses. It is one of the most magnificently coloured Coleoptera of this province,

Digitized by Google



W.J.CHIDLEY DEL

Digitized by Google

Digitized by Google

but its beautiful tints are so evanescent that a few days after death scarcely a trace of them remains, being merged into a uniform dull yellow or red. By this disappearance it is proved that the glowing colours are not due to any pigment, as in most insects, but the action of light upon its internal living tissues. These tissues shrink when losing their moisture after death, and thereby also lose the property of exhibiting the glowing metallic tints mentioned; consequently no museum specimen can reveal the fact to a distant entomologist.

The beetle belongs to the genus *Paropsis*, so numerously represented in Australia. The sexes differ slightly in size, the female being about five-sixteenths of an inch in length, and the male a quarter of an inch. All the outer integuments are smooth, excepting microscopical grooves and dots upon pro-thorax and elytra. The outline of form is that usual to the genus, a somewhat broad oval, slightly compressed. The head and prothorax are light green; the eyes, exterior edges of the maxillæ (with large triangular terminal lobe), mandibles, and the edges of the four last joints of the antennæ are black or dark brown, the remainder of the mouth parts and antennæ are light yellow. The margin of the elytra is yellowish green, and finely pitted; this is succeeded by a narrow band of dull purple, followed by another of green with metallic lustre; the outer edge of the latter is smooth, the inner shows three serrations, rendering it unequal in width at different parts, and is again—but irregularly—bordered by dull purple. Near the narrow purple median line two longitudinally extended spots of somewhat irregular form occur on each side, resembling burnished gold in colour and lustre, the anterior one preceded by a small bright crimson dot in the angle between the commencement of the green band and the metallic golden spot; the posterior one being succeeded by a rather larger one of the same bright crimson; the remaining space is filled in by a dark dull blood-red colour. The underside of the whole body is yellowish green, and the legs pale greenish yellow.

EXPLANATION OF PLATE IIIA.

Fig. 1. New hemipterous insect, as seen from above, enlarged twelve times.

Fig. 2. Anterior part of same, showing the proboscis partly removed from the sheath; the large coxæ, and quadrangular form of the anterior part of the body.

Fig. 3. *Paropsis* spec. nov,, enlarged six times.

Digitized by Google

Plants of Kangaroo Island.

By J. G. O. Tepper, F.L.S., Corr. Memb.

[Read July 15, 1884.]

From the 9th to the 19th of last month I spent on Kangaroo island, engaged officially in collecting specimens, principally zoological and mineral, for the South Australian Museum. The locality so examined only extended from Queenscliffe to Cape Willoughby and back to Hog Bay. In this examination six days were spent, and subsequently I examined the neighbourhoods of Queenscliffe and Brownlow for a few days more. Availing myself of the opportunity I gathered as many plants as circumstances permitted without neglecting the chief object of my visit. Besides the plants thus collected, others, well known to me, were dotted off on the margin of Professor Tate's excellent census of the Kangaroo Island flora.

The time was about the most unfavourable part of the year considered botanically, and therefore the result is much smaller than it would have been if the journey had been undertaken in spring or early summer, or if I had leisure to examine carefully some more favourable localities. Notwithstanding these disadvantages 214 species noted in the above work were observed or collected, and 18 species and varieties not mentioned therein, besides several too imperfect to allow certain identification. In enumerating these 18 species, inclusive of varieties, such remarks will be made regarding their habits as appear to be worthy of note.

Billardiera scandens, Smith (Pittosporeæ).—It occurs in the scrub west of Cape Willoughby, the soil consisting of sands and sandy clays over granite, quartzites, &c. The same plant also occurs in a small circumscribed area east of the public cemetery between Clarendon and Kangarilla, and is easily known by its narrow leaves with recurved and undulating margins, yellowish flowers, and other distinctions.

Correa speciosa, cor. variety viridiflora, Andrews (Rutaceæ). *Correa speciosa*, variety glabra, Lindley.—The former is plentiful in rather low-lying sandy parts of the scrub from Queenscliffe around American Beach, &c., and forms tall, intricately branched, very dense shrubs from two to seven feet high with small leaves and greenish flowers. The latter was only noticed on the limestone hills close to the coast of Queenscliffe, forms very low, weak, semi-prostrate shrubs about 12 inches high,

Digitized by Google

and very small white flowers. The real typical C. speciosa, with its large, yellow-red, bell-shaped flowers, was noticed sparingly on the high ground west of Cape Willoughby, forming, as it ever does where I have seen it, low, open, erect shrubs, some 8 to 12 inches high. Bentham, in recording the first two as varieties (Flora, I., page 354), says:—"I follow F. Mueller in uniting under one name all Correas with a truncate four-toothed calyx, united petals, and four of the filaments dilated. At the same time, although the following races may be found to pass into each other, yet they appear generally so distinct, that I feel some hesitation in refusing to recognise them as species." In these sentiments I am sure many, and not laymen only, will heartily agree, as it seems strange indeed to call dissimilar plants by the same name. In my humble opinion the term "*variety*" ought to be limited to florists' flowers, *where it is known* that the seed of any one plant will produce seedlings of different or aberrant forms, freely intercrossing, and again producing varied offspring in fairly even proportion; and to such spontaneous, aberrant, and inconstant forms in natural circumstances, where they are intermixed indiscriminately, so that without any stretch of imagination it can be assumed that they resulted, as in the former case, from the seed of a common plant. I doubt if any one knowing the above three plants in a living state could assume that the seed of either would give rise to all, especially as they occur in circumscribed areas far apart, seldom intermixed—C. glabra, for example, in Victoria, South Australia, and Western Australia; in the last, I believe, the only form. Let such well-marked forms as these stand as species, under a distinct simple appellation, till they be proved to be varieties in the sense mentioned above.

Templetonia sp., very likely T. retusa, R. Br. (Legumin).—An erect slender shrub, 2 to 2½ feet, with obovate leaves one inch or more in length, on the limestone hills west of Mount Tisbet. No flowers were seen.

Acacia notabilis, F. v. M.—A low, slender tree with few branches. In sandy scrubs near Brownlow and elsewhere, and of the same habit as in Yorke's Peninsula.

Acacia longifolia, Willdenow.—A tree or shrub much resembling the Golden Wattle (A. pygnantha) in size and habit, excepting that the leaves are much narrower and the bark lighter and smoother. Plentiful at White Gum Gully, south of Hog Bay, along the roadside.

Melaleuca decussata, R. Br. (Myrtaceæ).—A small shrub two to four feet high. On the rich, loose soil in the depression between the limestone ridges west of Mount Tisbet.

Eucalyptus goniocalyx, F. v. M.—Fair-sized trees, Hog Bay

Digitized by Google

River. E. odoratus, Behr. (Peppermint gum), near Antichamber Bay.

Aster tubuliflorus, F. v. M. (Compositæ).—Sandy scrub near Brownlow, &c.

Scævola humilis, R. Br. (Goodeniaceæ).—Low ground near Lashmar's Lagoon and Antichamber Bay.

Westringia sp. (Goodeniaceæ).—An erect shrub 2 to 2½ feet high, with slender branches and pale puce or white flowers, small leaves in whorls of three and slender straight branchlets; possibly W. eremicola, A. Cunn., or a species related to it. It occurs, but not plentifully, in the scrub west of Cape Willoughby. Fruit not seen.

Styphelia Woodsi, F. v. M. (Epacrideæ).—A low, dense, erect shrub on the limestone hills west of Mount Tisbet.

Callitris sp.—A small shrubby tree only a few feet high, the leaves of which are very different from those of the only other two species hitherto known in South Australia. Mr. Horswill, third keeper lighthouse, Cape Willoughby, handed me the specimen seen, but without fruit.

Xanthorrhœa sp. (Liliaceæ).—The "Yacka (Yucca?) Tree" of the islanders. It forms one of the most peculiar features of the island, its stem 6 to 12 inches thick, rises sometimes to a height of 12 feet, is either branchless or bears a few, but these seldom number more than two or three. The leaves are long, narrow, stiff, and brittle, resembling those of X. semiplana, but the midrib is more prominent; the spike reaches 8 to 10 feet in length, being 1¼ inch and more in diameter. Bentham's description of X. arborea suits best for it, but it is more likely a related species (if not the same) to that recorded from Flinders Island under the name of X. hastilis, R. Br., by Gunn in Hooker's Flora of Tasmania, of which Bentham says (Fl. Austr. vii., 115) it "must belong to some other species, but having no specimen it is impossible to identify it." Certainly it is neither X. quadrangulata, F. v. M., which occurs sparingly near Cape Willoughby, and has evenly four-sided grass-like leaves; nor X. semiplana, which is stemless, and has quite different leaf-marks on the interior of the rind.

Lepidosperma lineare, R. Br. (Eyperaceæ).—In the scrub lands of Hundred of Haines and elsewhere. A usually large form compared with the specimen observed about Clarendon, &c.

Poa syrtica, F. v. M. (Gramineæ).—A low, stiff, small-tufted grass near high-water mark along the beach at Brownlow to Cygnet River.

Lagurus ovatus, L.—Probably introduced, a conspicuously white-headed grass about Queenscliffe.

A very curious aberrant form is also shown by *Ixodia achylloides*, compared with the very common plant, inhabiting

Digitized by Google

the higher slopes and ridges of the Adelaide ranges. At the latter locality its stems and branches are regularly and constantly four-sided, thick, and fleshy; those of dwarfed specimens a few inches high always compressed. In the island this form also occurs near Cape Willoughby, but sparingly and intermixed with another which spreads over most of the scrub lands between this place and Queenscliffe, with slender, round, woody stems and branches, very different in aspect, but the flowers are apparently similar. Blooming specimens vary from one inch in height above the ground to two feet.

A very pretty green Alga occurs near Queenscliffe which I have not noticed either at Ardrossan or elsewhere in St. Vincent Gulf, viz., *Caulerpa scalpelliformis*, Aghard. Its leaf-like branches are toothed, almost pinnate, and grow from a thick base forming large tufts.

Specimens of all the plants (except the Xanthorrhœa) were submitted to Baron Sir Ferd. von Mueller, who was so kind as to identify them for me in his usual most obliging manner.

Digitized by Google

VARIATION OF THE COMPASS IN SOUTH AUSTRALIA.

By CHARLES HOPE HARRIS.

[Read August 5, 1884.]

[ABRIDGED.]

The first information we have as to the variation (declination) of the compass in South Australia is that Flinders, in 1802, when off Eucla, crossed a line of no variation—the needle, which had been pointing west of true north, showed no variation for a short distance, and then pointed east of true north, the declination increasing as his vessel advanced along the coast. The first reliable magnetic bearing known to the author is one given by Colonel Light in 1837. It is shown on a plan of the city of Adelaide and surrounding sections, drawn by Arrowsmith, in London. It shows one of the leading survey lines N. 8° 47′ W. The true bearing of this line, determined astronomically by the author, is 3° 33′, so that the variation in 1837 was 5° 14′ E. In 1841 a Mr. Forrest (of the Royal Sappers and Miners) officially recorded the variation as being 5° 9′ E. at the north-west corner of the city. In 1850 Mr Painter, well-known as an efficient and painstaking surveyor, observed the variation at Cape Willoughby to be 5° 6′ E. In 1857-9 Mr. Goyder, Surveyor-General, found the variation to be at Mount Remarkable 5° 39′ 13″; at Mount Serle, 5° 0′ 6″; at Termination Hill, north of Lake Torrens, 5° 22′ 40″; and near Mount Margaret, about 4° 3′; so that we have the variation since 1837 fairly well recorded.

The next question of interest is whether the variation is at present increasing or decreasing, and what the amount of change known as the "annual variation" may be. Dealing first with Arrowsmith's plan, the magnetic bearing of the line given in 1837 as 8° 47′ W. is now 9° 15′ W., showing an *increase* of 28′ in 45 years, or at the rate of 36″ per annum.

Taking, next, the variation given by Forrest in 1841 of 5° 9′, the mean variation read off by the author on the same spot with three needles has varied from 5° 30′ to 5° 43′. These values indicate an increase at the rate of from 30″ to 45″ per annum.

During the last six months the author has been systematically recording magnetic bearings in the city of Adelaide, with the following somewhat remarkable result:—The mean aggre-

Digitized by Google

gate bearings of the streets parallel to North and South terraces are found to be 30′ higher than the mean aggregate bearings of the streets parallel to West-terrace and King William-street, even after all allowance has been made for defect of alignment, and due precautions taken to secure their intersections at right angles to one another. The average of 80 readings brings out a magnetic bearing of N. 81° 10′ E. for streets parallel to South-terrace, and of N. 9° 20′ W. for King William-street and the streets parallel to it. The true bearings, determined astronomically, are 86° 28′, and 3° 32′ respectively; so that one set of observations gives a magnetic variation of 5° 18′, and the other a variation of 5° 48′. The discrepancy is attributed by the author to local attraction—as, for instance, by telegraphic wires, gas and water mains, building stone* &c. The author is disposed to believe that the latter more nearly represents the true magnetic bearing.

It is difficult, however, to assign a definite value to the magnetic declination at any epoch until the laws of the diurnal and other oscillations are more completely known. The author has made many observations on the diurnal oscillation. At Adelaide the needle moves towards the east from about 8 a.m. until after 1 p.m., and returns during the afternoon to the position it occupied in the morning. This is, of course, the inverse of what is observed in the northern hemisphere. The range at Adelaide was observed by the author to be 13′ in December, 1883; 4′ in May, 1884; and† as much as 16′ in October, 1884.

* The author has found the stone walls of his house to be strongly magnetic.

† Added since the paper was sent in.

Digitized by Google

Notes on the Crepuscular Glimmer or Red Glow.

By W. A. Jones.

[Read September 2, 1884.]

There have been several theories suggested to explain the phenomena, namely, volcanic dust, meteoric dust, ice, and vapour.

Although the dust theory has seemed most popular, I think it can be shown that the mass of evidence against it is overwhelming, and that the theory connecting the glows with some peculiar deportment of vapour is the only one competent to explain the most important phases.

Having carefully observed for upwards of eleven months, I have gleaned a number of interesting facts tending to prove that some form of water is present. But, apart from these, there are a number of facts controverting more or less the dust theories.

Bluish-green suns have been noticed at various times. To my own knowledge the same appearances of the sun took place in England in 1866 in the summer, and in Australia in 1879. The statement that the sun is green is not borne out by experiment with the polariscope, as if so the sun should appear green when the light is dimished. The bluish-green appearance reported appeared to be a subjective phenomenon to the excessive light of the sun it not too brilliant to prevent its being looked at for a short time.

According to Captain Lee's experience of 12 years the harmatan, a so-called dry fog, consists of remarkably fine red dust—1. The whole sky is tinted a dirty red. 2. The tinge is evident by moonlight. 3. The moon and sun are both reddened as they set.

But during the glow period the moon on setting and rising portrays no sky colours and gives only a white misty twilight that varies in brightness and extent with the moon's phases. No cross polarization is observable in the moonlight before or after she rises or sets.

We have important evidence in the fact that the glow changes in extent, intensity, in tint, in form, and in time of duration, as my notes conclusively show.

General Strachey has collected the barographs from the chief meteorological stations, and shows that a great wave passed

Digitized by Google

round the earth both east and west immediately after the Krakatoa explosion. After reductions for temperature he found that the excess of velocity of waves travelling east over the velocity of waves travelling west was about 32 miles an hour, and he states how this may be explained by the fact that the winds along the wave paths would on the whole be from the west, which would cause an increase in the rate of one set and decrease in that of the other, so that the difference of 32 miles would correspond to an average westerly wind of 16 miles an hour.

Now, the dates on which the phenomenon was recorded at various places necessitate a rate of progression averaging 2,000 miles a day, and we can hardly imagine this average increase being set up over at least half the equator so immediately after the eruption, whilst from various persons we get the news that these colours were seen before the date of the eruption even commencing.

At the Mathematical Society, Port Adelaide, February 27th, when the subject was before that Society, I stated that I had seen similar appearances in July, 1883, especially in the mornings, and also that in February, when at Port Victoria, I witnessed some of the most beautiful rosy sunsets, which I likened in my letters home to the fairy transformation scenes.

Our Astronomer Royal, Mr. Chas. Todd, C.M.G., stated that he had news of these appearances occurring before the date of the explosion.

Mr. Neison, Government astronomer of Natal, says that they commenced there in February, 1883, but on a less grand scale, gradually becoming more marked until June. For the next two months nothing was noticed. At the end of August they became most vivid—on the 21st and 22nd noticeable but not vivid, next five days stormy with much rain and lightning, on 28th and 29th vivid, 30th rainy, 31st vivid. In September, 1st, 2nd, 3rd, and 5th vivid, and most remarkably fading away into green and purple in the east. Then a week of much rain, and the displays vanished for four months.

Now for a remarkable point. In the Transvaal they were first noticed on September 2, and were prominent there whilst invisible at Natal, though the places were only separated by a distance of 250 miles.

Sydney Hooper states that he has observed sunsets for 30 years, and has always found the crimson glow coming a considerable time after other tints.

E. Ranstorm, a landscape painter, states that from 30 years experience he is certain similar displays take place every year.

The analysis of snows and rains has given entirely different results in various cases:—1. The analyses by Nordenskòold, the

Digitized by Google

celebrated Arctic explorer, show that snow which fell in Sweden contained iron, silica, phosphorus, and cobalt, the quantity of the last named being relatively great. 2. In a communication to *Knowledge*, an F.R.A.S. claims to have found in hailstones which fell at the period of a fine glow green plant cells, spores of fungi, a few diatoms, and some rotifera or their eggs? 3. Matticu Williams examined snow that fell at Harrow, and found large quantities of black oxide of iron easily separated by the magnet from the remainder of impurities. Some of his experiments leading him to infer the presence of nickel in the iron, which is characteristic of meteoric iron, he considers it to be meteoric. 4. Mr. Ranyard examined this and found it satisfactorily free from terrestrial dust. 5. Of McPherson's analysis we learn that the snow he collected contained hypersthene, pyroxene, magnetic iron, and volcanic glass, all of which were present in the volcanic ashes—(6) whilst M. Renard states that he finds the dust which fell at Batavia from Java to consist mainly of glassy particles, among which may be distinguished plagioclase, augite, rhombic pyroxene, and magnetite, the silica amounting to 65 per cent. Now, although the silica amounts to over half it has not been noticed in the majority of dust samples dragged out of the air by snow, rain, or hail. Again, there is no proof that the snow, &c., might not have brought its impurities from the lower strata of air most likely to be dust laden.

The absence of the rainband in the spectrum is no proof that the air does not contain water in some form. Thus, although it has been shown by a number that the glow has been existing when the spectroscope has shown an absence of watery vapour, the results of an investigation by F. W. Cory, of England, and presented by him to the Meteorological Society, show that a rainband as high as 75 per cent. was followed by a slight rain, and one of 10 per cent. by a heavy fall of snow. They also shew that the spectrum is not affected previously to a snowstorm except negatively, as the rainband diminished several days before snow. He suggests that when vapour is transformed into crystals of snow it does not give a rainband. Observations with the rainband spectroscope are not accepted by all meteorologists. "For example," says Hazen, "if it is turned to different parts of the sky and then to a white wall 50 feet or so distant it will be found impossible to tell between the rainband of the whole sky and that of the 50 feet," and "yet," he says in his paper to the Philosophical Society, Washington, "we find it insisted that the instrument must be turned to different points in the sky."

I thought at first that this objection was hardly fair, and I

Digitized by Google

attributed the similarity of spectra to the white surface reflecting proportionately the sky-light and all its peculiarities, and judged that if the spectroscope were brought within a few feet of the wall the lines would remain the same. I tried them with a white wall and found that the absorption lines disappear almost completely at an interval of three or four feet. When 20 feet off I noticed a nearly similar spectrum to that of the sky. On another occasion with a white disc I got most lines up to within a few inches of the slit. Thus one part of the sky might indicate by absorption bands in its spectrum a condition that was only the reflection by this portion of sky of absorption that occurred elsewhere.

The observations of equally eminent men show that the rainband is often seen at glow times:—1. At an early period of the glow, Ellery stated that the spectroscope indicated excess of moisture. 2. The reports from Magdeburg state that in the spectrum of the glow uncommonly strong rainbands were seen. 3. Professor M. Smith, of Madras, stated that a great amount of watery vapour was indicated as being in the air. 4. J. F. Donnelly had variations of absorption during one observation. He found in place of the rainband shading off from D towards E, a broad band shading off towards *a*. In a short time this band nearly disappeared, and *a* became prominent, shading off both ways, &c.

Upon consideration it appears that if the vapour were low down we might get rainbands, whilst if the vapour were high up with dry air lower down we might get dry air spectrum. And conditions could exist so that we might get both dry air and vapour bands. This is important, and in the report by J. H. Poole this case actually exists. In reference to the examination during February with one of Browing's micro-spectroscopes and comparing the results with spectrum measured in wave lengths, he finds in connection with the variable telluric lines absorption both by dry air and vapour. Thus there was nearly total obscuration of violet end of spectrum, dark green very faint, red end very brilliant, little *a* just visible, B broadened to a thick black stroke, and *c* enveloped in an aqueous vapour band. Between *c* and D, about 63, was a dry air band very sharp, but the principal dry air band was between 57 and 58. On the immediate side of D nearest to *c* was a vapour band. My own examination with the spectroscope shows that in the majority of cases where there is a glow the rainband is somewhat prominent during the early part, low down, frequently disappearing rapidly towards the latter end of the glow.

The existence of a halo or corona round the sun, the relations it bears to the glow, its inconstant character, and its intimate

Digitized by Google

connection with meteorological changes, cannot be explained by the hypothesis that it is due to dust. The halo or corona round the sun is very frequently visible now, and has been before the date of the glows.

In 1880, in connection with a set of inquiries I had resolved to make into the zodiacal light, I had been paying particular attention to the appearance of the sun's surroundings, and I find that many items of the following notes agree closely with those relating to sky appearances near the sun in 1880 and at other times doubtless:—The sky rarely has the same tint over its whole surface, the blue tints being about midway from sun to horizon, approaching the sun and horizon at certain times and states of weather. The change of tint near the sun forms a halo. This changes in form, it is not always circular, in fact it is rarely circular. Its limb has various breadths. It always changes as the sun approaches the horizon. It changes in tint as the sun sinks and rises. As the change from sunrise to noon is similar to sunset but in somewhat reverse order, I shall only describe the change as the sun sinks. As the sun sinks the central area becomes apparently brighter. The breadth of the limb increases on the side nearest to the horizon. It then appears pear-shaped towards sunset. The central space lengthens from the sun on the side farthest from the horizon. The rate of change is not constant, increasing as the sun sinks. The tint of the halo is not the same at the same time on various dates. It varies from a salmon tint to a panther tint, and frequently it has different tints in different parts. The panther tint occurs when somewhat heavy clouds are present obscuring portions of the halo, which is then much more extended. When it is this colour the glow is not prominent. The rain-bands low down are then heavy. The glow varies with the halo. As the sun still sinks this pear-shaped surrounding divides at the apex, forming two dusky pyramidal columns whose base rapidly extends north and south along the horizon, changing in tint at different parts. These bases do not travel north and south to like extent. Seen from various parts in this colony they generally seem to travel farthest north. As the sun sinks below the horizon the brilliancy of the central part becomes apparent directly, so that it appears to increase in brightness. Its tint then varies from a steel colour to yellowish white on various days. This central portion seems to extend to the point occupied by the limb before it divided. When the halo is extended the glow lasts a long time. When salmon-tinted the glow is lengthy. When there is no halo there is no glow proper, but a yellowish or orange bar followed by a whitish shimmer. There have been a few splendid greenish twilights in form and duration nearly equal to the

Digitized by Google

glow. On these occasions the halo was extended and had a tawny hue.

There are others who have observed the surrounding about the sun. Bozuard says:—"On November 28 an attenuated white vapour extended 30° or 40° from the sun." A number of others observed a similar phenomenon, and from their observations conclude that it was due to ice spiculæ. Mr. Kershaw, in *Knowledge*, describes the halo as a kind of rosy glow with its inner edge about 5° from the sun and outer boundary from 20° to 25°, and says ice spiculæ would account for its appearance within 20° to 30°, but its appearance within this puzzles him. Mr. Talbot, of the Transvaal, has forwarded news of appearances round the sun, and has also noticed that the halo is most extended towards the horizon, and has noticed several points in the changes of this halo similar to the changes seen here.

Although many have imputed the formation of this halo to the light refracted through ice crystals, I can find no record of any one having made an extended scrutiny during the greater portion of the glow period. Now, my experience shows that this halo or corona, whichever it may be called, is continually changing; that the space between its limb and the sun is continually changing; that this space is rarely blue; that it generally approaches to white. The space varies in extent from the sun from about 18° to 25° to 3° or 4°. The breadth of the limb frequently amounts to quite 15°, and is often so as to not to admit of measurement. But the halos round the moon, when presumably due to ice, rarely exceed in the breadth of their limb 2° or 3°. The solar halo has existed right on for a number of days, and the moon has been visible also during that period. If the halo be due to ice, the halo should also have been observable during night round the moon. My notes show that it has only been observable to me once when there has been a glow, and then it occurred late in the evening, whilst on the following morning there was scarcely any glow, the colour of halo during the day not being red, clouds being present more or less.

On the other hand, the moon has (according to my notes) been visible when the glow was prominent, and has frequently been enveloped in mist, as also some of the brighter stars and planets, whilst on all occasions when a halo round the moon has been visible it has evidently been due to matter that took the form of clouds, though not always exactly the same. On all these occasions (about 15) there was no glow.

There is evidence to show that vapour tints are not dependent on a definite angle so precisely as ice tints are. In support of this I quote authority. Herschel, in his meteorology, describes

Digitized by Google

colours seen by him and a friend in Kent in 1841, thus:—"Bands of colour not in circular form around the sun, following the sinuosities of the clouds. The colours commencing from the white area forming the interior and proceeding outwards to its edge were—1st, white; 2nd, very pale pink; 3rd, blue green, a very strong colour; 4th, at the edge purplish pink considerably intense, beyond which pure blue sky. The same tints were on other clouds having no reference to the more or less proximity to the sun, but depending on the thickness of the cloud or the length of the path within it traversed by the visible rays. In fifteen minutes the bands grew broader and tints stronger, and a tendency to form a corona round the sun." "It seems impossible," he says, "to regard these colours other than the resultants of the superposition of a series of interference fringes following a regular progression of breadth due to an increasing size in the drops from the exterior to the interior of the clouds."

Forbes has shown that steam in the act of expanding, and while still transparent, is highly absorptive of the violet, blue, and a portion of the green rays of the spectrum. Supposing the vapour only in the form it had on the outside of these clouds, the red would reach us when the other tints had become faint, and yet cloud forms not exist definitely.

We have also the well known fact of hygrometric relations of air to its temperature, and also the different tints the air has before clouds form and as soon as they do form —the depth of air being seen through the numerous gaps. Thus the pure ultramarine is most marked after clouds form. And before they appear at certain temperatures the sky has a greenish blue appearance. If the upper portion of the atmosphere were at a slightly higher temperature, and if the radiation of heat by the earth had increased we might expect transparent vapour at a higher altitude than usual, or at altitudes in greater quantity than previously. There is no necessity for assuming the quantity to be great, as if so it would cause precipitation to suit the ordinary temperature. The constitution of this vapour would certainly change, and we might expect it to form into its approximate condition to watery vapour (like air charged up to the highest dew point) and to reverse its phase about sunrise with the reverse order of change in temperature.

There are further observations tending strongly to prove that the cause lies in some form of water, as I shall immediately show; but I would just refer to several difficulties, if we assume that this water came from space. Thus, if it consisted of a small-sized cloud of vapour or ice the probabilities against it striking the earth would be enormous. If it were a

Digitized by Google

large-sized cloud it must have come from a great distance and would have appeared as a nebulous patch, which as it approached could hardly fail to be noticed by some of the numerous astronomical observers. But of such a phenomenon we have heard nothing. We know that cometary tails are very attenuated, and on the occasion not long ago when we expected to pass through the tail of a comet there were no extraordinary sun glows recorded. The date of this transit, as predicted by Mr. Hind, was June 30th, 1861, and there is very little doubt that the earth did pass through this tail. If the earth passed through fairly it must by reason of its atmosphere have cleared a pencil 8,000 miles in diameter at the very least and half a million miles long, of all the fine matter in that path of the earth, and yet have done this without producing any marked meteorological changes. If the tail were composed of vapour frozen or otherwise it must have been remarkably attenuated, and if dust or meteoric matter it must have been exceedingly fine, as no display of incandescence took place. The only thing noticed was a number of long faint streamers pointing to the nucleus of the comet and widening out. It is strongly probable from this that if a cloud of meteoric dust or if a cloud of aqueous vapour sufficiently extensive or dense to have supplied the atmosphere for these displays, had approached the earth, such clouds could not have escaped observation during both their approach and departure.

The polariscopic examination affords very strong evidence of watery vapour as the cause of the displays. From an extended scrutiny during the whole period the following facts are adduced by the writer:—The skylight is over the greatest portion polarised in planes passing through the sun. There is a neutral place in the sky. It varies in position, being farther from the sun towards evening and early in the morning. It is not always a point, sometimes it is an elliptic area difficult to define within nice limits. The term dark side is here taken to represent the east side in the evening and west in the morning. On the dark side of the sky the polarization is about at right angles to that of the sun side. This, however, is not constant. When there is a *reddish tint* on the dark side the polarization is at a tangent to the principal boundary of the tinted surface. This area generally has an altitude of about 30°, varying in shape and rarely passing the neutral point position. When the red tint is not apparent the space below the neutral point is brightest with the nicol in cross position. The form of this space in dry air and clear evenings, when tinted, resembles two spear-like columns thickest at the base and inclined to each other, crossing at the top. On evenings when there is to be a glow the red tint appears first on this dark side,

Digitized by Google

and this tint in the east disappears just when the red tint appears in the west. In cloud-patched sky the area is more extended and undefined, the tint more carmine, and duration longer. The radial polarization of the remainder of sky is not constant. When there is a red glimmer in the sun side the phenomenon of cross-polarization is apparent in the vicinity of this glow. Thus, when the long diagonal of the nicol is about perpendicular to the plane passing through the prism, the point of observation and the sun, the red tint is brightest. The position of maximum cross-polarization is continually varying in distance from the sun. It is not symmetrical. In this colony, from all the points I got intelligence, it is generally more perfect on the north of glow point. When there is a bluish green glimmer the cross-polarization is not observable in it. The cross-polarization varies with the kind of glow. It is frequently prominent beyond the limits of the red. It is best in weather when there are clouds about, and when the dew point is high. Sometimes it is visible in bright blue sky, the cross position of the nicol showing a fine red. Sometimes it is visible beneath the clouds when they are of large extent and the air seems hazy. It is not always necessary to turn the nicol 90° from the radial position, or from the position showing best blue, the red reaching its maximum in a very small angle. This is most marked when there are rain clouds not very heavy and dense, and especially when the spectroscope shows a heavy vapour band for a day or two previously. The clouds are generally low level bands, though it is also observable when the same kind of clouds are rising. When the cross-polarization is prominent the selenite colours are very fine, and seem to be most splendid at an angle of about 70° to 80° from the sun. NOTE.—This angle should be the angle of maximum polarization if it were due to water particles whose dimensions were not insignificant in comparison with light waves.

Placing a nicol-prism between the slit and the battery of a spectroscope, I examined the cross-position, and the result of a number of evening and morning scrutinies seems to show that when the nicol is in cross-position the spectrum is brighter at the less refrangible end, and that the principal absorption takes place between E and F. That when in the early part of the glow the lines in the red are broader when the nicol is radial and sharper when the nicol is crossed.

In examining the halo or corona I have tried to find the phenomenon of cross-polarization, but with very questionable success in the daytime. It seems to be present when there is panther-hue background and clouds obscure the sun. Cross-polarization also exists in variable degree when orange banks extend far from the sun, the cross-polarization deepening their

Digitized by Google

tint and extending it in altitude, this having existed since 1880. The glimmer is frequently bluish green to southward, with somewhat northern glow. In these cases there is cross-polarization in the glow and radial polarization and selenite tints in the glimmer, brightest latest.

How is the fact of cross-polarization to be explained? Supposing the red tints to be a species of fluorescence. This *could* give the phenomenon of cross-polarization, for in the cross position we should only have the fluorescent tint and the residual tint of the polarised sky light, and in the parallel position the tint from the admixture of the two lights. If this were true we should get a gradual change of tints in passing from one position to the other. That is, a change in intensity of the respective tints with the important fact that one hue would be brighter than the other. Thus, in the cross position the non-polarised light plus the residual would be less bright than the mixed tint of the two lights in parallel position. In this case the *cross* position would always give the *most* decided difference of tint.

If dust were present in an unusual degree and light were polarised by reflection from it, the result would be that one tint would be observed, for the plane of polarization would be parallel to that of the sky. Thus the tint would be brightest in parallel and darkest in cross position. If dust were present and sky somewhat uniform, whatever occurred in sky-light would occur in dust-light polarization. Supposing the residual or unpolarised light of the sky bluish, the residual light of the dust reddish, and that both were proportionately polarised. Then, in different parts of the sky the hue of cross position should be the same with only its difference of brightness due to varying completeness of polarization in various parts of the sky. Supposing the residual light of dust greatest. Then in positions of most complete sky polarization the red tint in cross-position would be brightest; that is, more decided, and the spectroscope with nicol-prism would reveal it at any time in the day. Next, the difference of tints as the neutral point were approached would diminish until the hue of ordinary sky tint at the time would be seen. The polarization of the sky is most perfect when the sun is above the horizon. When the sun is above the cross-polarization is rarely apparent, and at the point of best polarised sky-light the residual colour is bluish grey. Hence, cross-polarization cannot be due to this cause, for the residual light is that light which is unpolarised, and at the neutral point the sky-light is the residual light. But throughout my scrutiny this point is rarely reddish, and is never tinted with any comparison to the sky that is farther away still from the sun side;

Digitized by Google

this applying especially to the time when the display commences.

On the other hand, the observations seem to afford most conclusive evidence that the variable element water is, and that dust is not, the cause for these magnificent displays. Professor Tyndall, in his experiments into the formation of clouds by the action of light when *scrupulous freedom from dust was ensured*, found sometimes as many as four reversals of the plane of polarization, which may at times be also seen in the sky when cirrus clouds are forming. He showed that the position of the neutral point depended upon the degree of attenuation of the fumes or vapour employed. He showed that the effect of introducing various fumes among the common air motes did not change their character of polarization, simply making it more bright, whilst he showed that various vapours did alter the plane of apparent polarization. I here quote portion of his remarks wherein he says:—"But when a puff of aqueous cloud or of the fumes of hydrochloric acid, hydriodic acid, or nitric acid is thrown into the beam there is a complete reversal of selenite tints. Each of these clouds twists the plane of polarization 90°." Then again, his experiments on the Alps show that the alpen glow exhibits the phenomena of apparent cross-polarization, whilst the tints he describes must have equalled in beauty if not in extent those of the crepuscular glimmer. The glows in the locality mentioned could not have been due to dust, for his experiments on bacterial life go far to show that no dust was carried into those localities, and irrespective of this the tints are observed at the times when vapour would most likely be condensed.

The fact observed by Arago that the light of the halos is partially polarised in planes tangential to their circumference seems to show that they consist of refracted light, whilst the light of the rainbow, being completely polarised in radial planes, shows that water in various forms is competent to fulfil all conditions required in the crepuscular glimmer.

There are certain relations to the barometer and to temperature which I should be happy to communicate at some future time, the points not thoroughly dealt with for want of time being as follows:—The streamers; their angles, positions, and colours. Dew point; its relations. The barometer; its relations. The red glow on the dark side of the sky, and the order of colours then coming into view. The ordinary twilight existing often as long as the red tint, stars being visible through both. The clouds being seen as dark objects on high background any evening whether there be red tints or not. The streamers never occuring when clouds are absent. Their existence when there has only been the yellow sunset tints, the rays having similar tints. And various other points all favouring the vapour theory.

Digitized by Google

Descriptions of New Species of South Australian Plants.

By Professor Ralph Tate, F.G.S., F.L.S., &c.

[Read October 7, 1884.]

Sisymbrium procumbens.

A small glabrous annual, with a few prostrate branches radiating from a leafy rosette, usually under six inches diameter. Radical leaves on long petioles about one inch long, oblong, coarsely toothed or shortly pinnatifid; stem leaves few, lyrate-pinnatifid to spathulate. Flowers small, few, yellow. Fruiting racemes of the lateral branches about one inch long with slender spreading pedicels; the pedicels about two and a-half lines long, shorter than fruit; from the radical rosette there arise a few flowers borne on erect pedicels, the fruiting pedicels longer than the pods. Pod broad, about six inches long, blunt at the top, and slightly attenuated at the base, tipped by a short broad persistent stigma. Valves nearly flat, with a prominent midrib, and conspicuously longitudinally and reticulated veined. Sepals spreading, overtopping the yellow petals. Seeds small, ovate, moderately compressed.

Claypans near Termination Hill, Lake Torrens Plain, flowering in September. *R. Tate.*

Among Australian congeners, *S. procumbens* approaches to *S. nasturtioides*, from which it differs in habit, form of leaves, in the spreading not erect fruiting pedicels, stouter pods, &c.

Kochia pentatropis.

A perennial, with a hard, almost woody base, and a herbaceous erect stem of about two feet high, with short ascending branches not usually exceeding six inches. Branches and stem clothed with a white dense cottony wool, amongst which are long soft spreading hairs; young foliage pilose. Leaves rather crowded, sessile, alternate, varying from linear and semiterete to linear-spathulate, obtuse, rather thick, a-half to three-quarters of an inch long. Flowers solitary, axillary. Fruiting perianth, with hard obconic tube two lines long, with five very prominent vertical membranous wings, bordered by an incomplete horizontal membranous expansion of four to five lines diameter; summit of the perianth shortly pyramidal. The five lobes closing over the fruit are pilose at their tips.

Calcareous loamy soil between Mounts Playfair and Parry,

Digitized by Google

Aroona Range, and spreading thence along course of Mount Parry Creek. *R. Tate.*

This species has close affinity with *K. triptera*, and though the number of vertical wings is normally five for the one and three for the other, yet the latter has occasionally a fourth, as already indicated by Bentham, and the former has the fifth sometimes diminutive. Despite these approximating characters, there is the difference in habit, in shape and size of the fruiting perianth and its accessory parts, whilst the silky hairs of *K. pentatropis* is peculiar. In *K. triptera* the horizontal wings are united to form a complete ring, but in *K. pentatropis* the union is incomplete, there being always either one segment free or the continuity of the ring interrupted by at least one sinus decurrent along a vertical wing; moreover, the horizontal wing is more or less lobed between the vertical wings.

PULTENÆA GRAVEOLENS.

A wide-spreading shrub, usually about three, but attaining to five feet high; branchlets lax, somewhat drooping; branchlets, leaves, and calyx clothed with white soft hairs. Leaves alternate, oblong-linear, two lines long, obtuse or minutely pointed, margins slightly incurved, midrib prominent on the underside, shortly stalked. Stipules narrow-lanceolar, very small, persistent, yellow hyaline, and viscid while young. Flowers solitary in the upper axils, on peduncles half or nearly the length of the subtending leaf, forming short leafy terminal racemes. Bracteoles two, narrow-lanceolar, small, persistent, adnate to near the base of the calyx-tube, yellow-hyaline and viscid while young. Calyx ciliate, about one and a half lines long; lobes lanceolate, fine pointed, longer than the tube, the two upper ones broader and not so deeply cleft. Corolla fully twice as long as the calyx; standard, oval-cordate, a little longer than broad, yellow tinged with red at the margin and streaked with the same colour at the base; wings spathulate, yellow, as long as the standard; keel a little shorter than the wings, pale-yellow, with the upper half reddish-brown, brighter coloured on the inside. Stamens ten, free, of unequal length. Style filiform, glabrous, curved, a little longer than the stamens. Ovary longitudinally ridged, silky-hairy. Pod triangular-ovate in outline, half as long again as the calyx, valves slightly curved transversely, surface carunculate and covered with appressed silky hairs. Seed one, attached near to the base of the fruit by a strophiole, oval of a reddish colour except around the hilum, where it is black.

The foliage emits a strong odour like that of spirit contaminated with animal matter.

This species forms thickets in the open parts of the stringy-

Digitized by Google

bark forest at Uraidla, Mount Lofty Range, flowering in October. *R. Tate.*

In Mr. Bentham's arrangement of the species *P. graveolens* will find a place in the Section Cœlophyllum, in the neighbourhood of *P. procumbens.*

PULTENÆA VISCIDULA.

An erect shrub of three feet, branches and branchlets more or less clothed with short spreading hairs, the growing ends of the latter covered with a viscous exudation. Leaves linear-terete, slender, obtuse at the end, and attenuated into a short stalk, mostly about half an inch long, channelled above by the involute margins, shortly setose. Stipules small lanceolar, opaque, blackish-brown, while young translucent yellow. Flowers few in an umbel at the end of the branchlets, shortly stalked amongst many bracts; pedicels one and a half lines long, curved. Bracts imbricate, much shorter than the pedicels, ovate, bifid and bluntly keeled. Bracteoles inserted close under the calyx, concave and keeled, strigosely-hairy on the keel, shorter than the calyx tube. Calyx under two lines long, the two upper lobes acuminate, the others somewhat narrower and acute, strigosely hairy. Petals unknown. Pods two and a half lines long, ovate acuminate; valves very convex, pubescent.

Under the shade of *Eucalyptus corynocalyx* at Karatta, on the Stun'sail Boom-river, Kangaroo Island. *R. Tate.*

P. viscidula belongs to the Section Cœlophyllum, and should have a place near *P. hibbertioides*, from which it differs by the nature of the vestiture, viscosity, form of stipules and pod, short bracteoles, &c.

HYDROCOTYLE CRASSIUSCULA.

A stout glabrous annual with diffuse stems elongated to one foot or more, but not rooting at the nodes. Leaves three-fourths of an inch in diameter, divided to the petiole into three oblong cuneate lobes, each with two or three short segments. Stipules broad, jagged. Peduncles short, each with an umbel of ten or more small flowers on short pedicels finally as long as the fruit. Petals valvate. Fruit more than one line broad, but not so long, didymous; the dorsal rib much elevated, acute but not winged, the intermediate ribs semicircular acutely prominent with a few minute tubercles in the enclosed pit, and a single row on the outside. Carpophore persistent.

This species is closely allied to *H. trachycarpa*, from which it differs conspicuously in its coarser growth, more deeply divided leaves, shorter peduncles, and denser umbels.

Digitized by Google

Sandy heath-ground on the elevated central part of Dudley Peninsula, Kangaroo Island, flowering in November. *R. Tate.*

HAKEA EDNIEANA.

A tree of about twelve feet, with a somewhat hemispheric outline; branchlets and leaves clothed with short, appressed silky hairs. Leaves terete, once or twice bifid or trifid, rigid and pungent-pointed; the whole leaf usually under one and a half inch long, the divided portion somewhat longer than its stalk-like base. Flowers unknown; inflorescence a short raceme borne on a short axillary peduncle. Fruit one and a quarter inch long, three-eights inch broad, nearly straight except in the apical part, which is attenuated into a short upward-curved beak. Seeds unknown, but the impressions in the interior of fruit-valves indicate a smooth seed and a large wing.

Sparsely distributed over the stony slopes of the Aroona Range, bordering the Basin of Lake Torrens on the east. *R. Tate.*

When first observed by me, more than a year ago, the trees of the species were without flowers, and though my friend Mr. Malcolm Murray has since then frequently visited them, yet no advance to floral development has been made. Despairing to obtain the desiderated floral organs, at least for some time to come, I have thought it advisable no longer to defer the publication of those characters which seem to entitle the plant to specific rank; and in doing so I have much pleasure in imposing on it one of the names of the Conservator of Forests, Mr. J. Ednie Brown, F.L.S., whose "Forest Flora of South Australia" claims some complimentary recognition by the systematic botanist.

The protracted period intervening between the successive blossomings of this species is not singular, as other arboreous vegetation of this region exhibits the same phenomenon, notably so *Melaleuca glomerata*, which flowered during the exceptionally dry summer of 1883 after an interval of at least three years.

H. Ednieana has the unique foliage of *H. purpurea*, but in other particulars it seems to be markedly different.

STIPA MUELLERI.

Stems several feet long, wiry, slender, quite glabrous, with erect branching flowering shoots, sometimes scrambling over bushes. Leafless, except closed sheaths at the joints terminating in a small erect lamina, and membranous sheathing scales at the base of the stem. Ligule very short, not ciliated. Flowers racemose, of one, two, or three one-flowered spikelets on long filiform pedicels. Outer glumes exceeding one inch, acute; exterior glume purplish, inner green. Flowering

Digitized by Google

glume on a rather long silky-hairy stipes, seven lines long, adpressed silky-hairy, the hyaline involute margins ending in a very thin acute lobe on each side of the awn, fully two lines long. Awn glabrous or minutely scabrous, stout, three inches long. Palea as long as the entire base of the glume, glabrous or minutely pubescent. Superior lodicule linear lanceolate, hyaline, two and a-half lines long; the inferior lodicules shorter, linear-oblong, opaque-white, hyaline and toothed at the end. Stamens three, anthers five to six lines long, with divergent and hair-tufted points.

Open parts in the stringybark forests (*Eucalyptus obliqua*) at Uraidla, Mount Lofty Range, and scrub lands about Mount Jagged, towards Encounter Bay; flowering in October. *R. Tate.*

The species is dedicated to Baron Sir F. von Mueller, F.R.S., as a slight tribute of my personal esteem, and in grateful acknowledgment of the assistance rendered me in my studies of South Australian plants.

Among Australian congeners this new species occupies a place near *S. flavescens* and *S. teretifolia*, from both of which it is conspicuously different by its branching leafless habit and paucity of flowers.

Digitized by Google

Additions to the Flora of Extra-Tropical South Australia.

Compiled by Professor Ralph Tate, F.G.S., F.L.S., &c.

[Read October 7, 1884.]

Sisymbrium procumbens, Tate. Claypans on Lake Torrens Plain, at the foot of the Aroona Range. *R. T.*

Bergia ammanioides, Roth. Fl. Aust., I., 180. Cooper Creek at Innaminka. *James McLeod!*

Triumfetta Winneckeana, F. v. M., in "Supplt. Census Plants of Australia." Central Australia.

Kochia pentatropis, Tate. Between Mounts Parry and Playfair, Aroona Range. *R. T.*

Scleranthus diander, R. Brown. Fl. Aust., V., 260. South Australia. *F. v. M.*, in "Supplt. Census," &c.

Isotropis Winneckeana, F. v. M., in "Supplt. Census," &c. Central Australia.

Pultenæa graveolens, Tate. Stringybark forest at Uraidla, Mount Lofty Range. *R. T.*

Pultenæa viscidula, Tate. Sugar-gum tree forests at the Stun'-sail boom River, Kangaroo Island. *R. T.*

Templetonia aculeata, Bentham, Fl. Aust., II., 170. Kanyaka, Flinders Range. *Mr. S. Dixon!*

Bauhinia Carronii, F. v. M., Fl. Aust., II., 295. Central Australia. *F. v. M.* in "Supplt. Census," &c.

Acacia erinacea, Bentham, Fl. Aust., II., 345. Eucla. Com. by *F. v. M.*

Haloragis digyna, Labillardiere, Fl. Aust., II., 475. Eucla. Com. by *F. v. M.*

Eucalyptus Oldfieldi, F. v. M., Fl. Aust., III., 237. Finke River, *H. Kempe.* Com. by *F. v. M.*.

Hakea Baxteri, R. Brown, Fl. Aust., V., 501. Near Eucla. *W. McMinn.*

Whilst engaged on the construction of the telegraph line across the Bunda plateau Mr. McMinn gathered seeds of native plants, from which Mr. F. C. S. Driffield succeeded in raising a Hakea. This Hakea has in the last two seasons borne flowers and fruits, and from these materials, obligingly placed at my disposal by Mr. Driffield, the above specific determination has been made.

Hakea Ednieana, Tate. Stony slopes of Aroona Mountain and Mount Parry. *R. T.*

Digitized by Google

Hydrocotyle crassiuscula, Tate. Dudley Peninsula, Kangaroo Island. *R. T.*

Pterigeron adscendens, Bentham. Fl. Aust., III., 533. S. Australia *F. v. M.* in "Supplt. Census &c."

Senecio platylepis, DeCandolle. Fl. Aust., III., 662. S. Aust. *F. v. M.*, op. cit.

Centunculus minimus, Linn. This addition to the Flora of Australia was obtained by me, in November, 1882, in abundance on swampy ground about Mount Graham, Lake Edward, and at Lowan near Tarpeena in the South-East; but in deference to the opinion of Sir F. von Mueller the insertion in the list of indigenous species was withheld; however, that author has since found it himself at Mount Macedon, Victoria, and has catalogued it in his recent "Supplement of the Plants of Australia."

Veronica Anagallis, Linn. This species grows abundantly in the swamps about Lake Bonney, Millicent, and Mount Graham, and as it is unaccompanied by its usual European associates—*e.g.*, *Nasturtuim officinale*, *Sium angustifolium*, *Œnanthe spp.*, *&c.*, it may be of endemic origin.

Mimulus gracilis, R. Brown. Fl. Aust., IV., 482. Swamps near Penola. *Samuel Dixon!*

The *M. gracilis* of my census belongs to *M. prostratus;* but the inclusion of the true *gracilis* can now be retained through Mr. Dixon's discovery made last year.

Buechnera linearis, R. Brown. Fl. Aust., IV., 515. S. Aust., *F. v. M.* in "Supplt. Census, &c."

Heliotropium tenuifolium, R. Brown. Fl. Aust., IV., 399. Central Australia. Com. by *F. v. M.*

Schœnus sculptus, Boeckel. Fl. Aust., VII., 376. Dudley Peninsula, Kangaroo Island, *R. T.* Port Lincoln. *Samuel Dixon!*

Stipa Muelleri, Tate. Open places in stringybark forests at Uraidla, Mount Lofty; heathy ground around Mount Jagged, Encounter Bay. *R. T.*

Digitized by Google

MISCELLANEA.

———o———

BOTANICAL NOTES.

By Professor Ralph Tate, F.G.S., F.L.S., &c.

[Read October 7, 1884.]

1. Kangaroo Island.

(a) Additions to the Flora:—

Threlkeldia diffusa was inadvertently omitted from my list published in last year's volume of the Transactions; it grows near the shore-line at American Beach, at Queenscliffe.

Templetonia retusa. Sand-hills at Cape Hart, Dudley Peninsula (T. W.* !)

Helipterum exiguum. Hog Bay River (T. W.!)

Thelymitra antennifera. Between Emu Bay and Discovery Flat (F. W. H.† !)

Prasophyllum elatum. Dudley Peninsula (Mr. T. Willson!)

Pterostylis barbata. Hog Bay River (T. W.!)

Caladenia dilatata, R. Br. Emu Bay to Discovery Flat (F. W. H.!)

Caladenia filamentosa. Hog Bay River (T. W.!) Emu Bay to Discovery Flat (F. W. H.!)

Caladenia latifolia. Same as last.

(b) The following species are no longer restricted in South Australia to Kangaroo Island, having been observed in the respective localities annexed:—

Hydrocotyle tripartita, at Lowan, near Tarpeena (R. T.)

Lobelia platycalyx, at Lake Edwards (R. T.), and at Yallum, Penola, by Miss Allen!

Schœnus sculptus, at Port Lincoln, by Mr. S. Dixon!

(c) Additional Localities:—

Drosera Menziesii, *Thomasia petalocalyx*, *Kennedya prostrata*, *Pomaderris obcordata*, *Styphelia Richei*, and *S. ovalifolia*, at Hog Bay River (T. W.!)

Grevillea ilicifolia. Between Emu Bay and Shoal Bay and towards Kinch's Station (F. W. H.!)

---

* T.W.—Mrs. T. Willson, of Hog Bay River.

† F.W.H.—Mr. F. Wm. Hicks, sometime resident near Emu Bay.

Digitized by Google

Diuris longifolia and *Caladenia deformis*. Emu Bay to Discovery Flat (F. W. H.) and Hog Bay River (T. W.!)
Caladenia carnea. Emu Bay to Discovery Flat (F. W. H.!)
Pterostylis præcox. Hog Bay River (T. W.!)

2. River Murray.

The following species, which are additions to the flora of this region, were observed by me in January of this year:—
Hibiscus Krichauffianus. Desert towards the Victorian Boundary.
Atriplex semibaccatum, *Erechthites quadridentatus*, and *E. arguta*. On the river-alluvium east from Overland Corner.
Sarcostemma australe, as a low shrub with erect stiff branches; on the desert between Chowilla and the Boundary.
Ottelia ovalifolia. Lagoons and still waters of the river above Overland Corner.
Lappago racemosa. Desert beyond Chowilla.
Danthonia nervosa and *Eragrostis diandra*. Alluvial flats above Overland Corner.

3. Adelaide District.

Scleranthus pungens and *Quinetia Urvillei*. Cliff slopes by the sea between Marino and Hallett's Cove (R. T.).
Scirpus littoralis. Margins of the River Torrens; it grows also at Wilpena Pound (R. T.).

4. Lake Torrens District.

Salicornia tenuis. Stony ground on Mount Parry, Aroona Range (R. T.).

BIBLIOGRAPHICAL NOTICES.

Recent Papers relating to the Palæontology of South Australia.

1. Fossils from near Mount Hamilton and Peak.

By W. H. Huddleston, in "Geological Magazine," August, 1884, p. 339.

Here are figured the following, to which the appended notes are mine:—
Natica, sp. *N. variabilis*, Moore.
Myacites (?) australis, n. sp. May be a *Pleuromya*.
Cytherea Woodwardiana, n. sp. Genus uncertain.
Cyprina, sp. A cast; generic position very doubtful.
Modiola linguloides, n. sp. A good species.
Gervillia angustata, n. sp. Founded on very obscure impressions.

Digitized by Google

Avicula orbicularis, n. sp. *Monotis Barklyi*, Moore.

The author remarks that the general facies is not dissimilar to Jurassic, but nevertheless inclines to agree with R. Etheridge, jun., that the fossils are Cretaceous.

The new material does not help to the solution of the question as to the age of our Mesozoic beds, and it will be well to hold to my opinion that they are Jurassic, as the fauna has slight community of species with the Jurassic rocks of West Australia, and none at all with the Queensland Cretaceous.

2. On some Cretaceous Fossils from Queensland.

By R. Etheridge, jun., in Trans. Roy. Soc., N.S.W., vol. xvii.

A species of *Aucella* is figured and described with the specific name of *A. Liversidgei*, but in a supplemental note is referred to *Avicula Hughendensis*, R. Etheridge, sen.

This is identically the same as the species of *Aucella* referred to by me (Trans. Roy. Soc., S. Aust., 1882), which was obtained from a wellsinking 260 feet deep at Mombra, near Mount Browne, on the frontier of New South Wales. The deposit yielding this fossil must therefore be placed on the horizon of the Queensland Cretaceous beds.

3. Remains of Trilobites from South Australia.

By Henry Woodward, in "Geological Magazine," August, 1884, p. 342.

This communication deals with two species of trilobites obtained from the Parara limestone, near Ardrossan, which are named *Dolichometopus Tatei* and *Conocephalites australis*. The generic determinations confirm the opinion previously expressed by me of the Lower Silurian age of the beds, the author remarking that "these trilobites are clearly of Lower Silurian age, being equivalent to the Swedish, Bohemian, Tasmanian and North American beds with similar fossils."

Ralph Tate.

Digitized by Google

ABSTRACT OF PROCEEDINGS

OF THE

Royal Society of South Australia,

FOR 1883-84.

ORDINARY MEETING, NOVEMBER 6, 1883.

H. T. WHITTELL, M.D., President, in the chair.

BALLOT.—Messrs. H. C. Mais, M.I.C.E., and F. W. Andrews were elected a Fellow and Corresponding Member respectively.

Prof. TATE moved, in accordance with a written notice of motion signed by five Fellows, and presented at the last meeting of the Society—"That Rule 37 be altered, so as to allow of the election of six other members of Council instead of four, as at present." The motion was put, and unanimously carried.

W. Haacke, Ph.D., and W. E. Pickels were then elected members of the Council.

H. T. WHITTELL, M.D., in a short eulogistic speech, proposed a vote of thanks to the retiring President, Mr. Charles Todd, C.M.G., which was carried with acclamation.

Prof. LAMB, M.A., made some remarks upon the "Persistency of Electrical Currents in Masses of Iron," and gave the results of his experiments in the matter. As the latter were not yet complete, he decided to withhold for the present their publication.

Mr. J. G. O. TEPPER, F.L.S., read some notes upon "Algæ found in St. Vincent Gulf," and exhibited specimens. He also gave some particulars respecting species of Paropsis and Heminoptera shown by him.

ORDINARY MEETING, DECEMBER 4, 1883.

H. T. WHITTELL, M.D., President, in the chair.

BALLOT.—Messrs. W. E. Chapman, R. Thomson, E. H. Wainwright, B.Sc., and R. L. Mestayer, C.E., were elected Fellows.

EXHIBITS.—Prof. TATE showed two new specimens of stipa, namely *S. Muelleri* and *S. teretifolia*, one found at Kingscote

Digitized by Google

and the other at Uraidla. Also, *Pultanea graveolens* from Uraidla, and *Mimulus gracilis* from near Penola.

W. HAACKE, Ph.D., gave a description of six new medusæ found by him in St. Vincent Gulf.

Mr. G. GOYDER, jun., gave some particulars respecting the action of carbonated waters upon iron pipes in the vicinity of Gawler.

ORDINARY MEETING, FEBRUARY 5, 1884.

Prof. TATE, F.G.S., in the chair.

BALLOT.—Messrs. H. St. Munton, D. J. D. Beresford, and J. W. Bussell were elected Fellows.

EXHIBITS.—Prof. TATE, F.G.S., showed an abnormal growth of the common *Sonchus oleraceus*. Mr. C. TODD, C.M.G., exhibited and explained an electric water level indicator, and also a miniature Gramme electrical generator. He also made some remarks upon the two comets, Pons-Brook and Ross.

Mr. W. E. PICKELS, F.R.M.S., referring to the desirability of a Postal Microscopical Exchange Society, moved—"That this meeting recommend to the Council of the Royal Society of South Australia that the Hon. Sec. (W. L. Cleland, M.B.) be requested to co-operate with the Hon. Sec. (W. E. Pickels, F.R.M.S.) of the Field Naturalists' Section in drawing up a circular to be issued to the Fellows of the Society and Members of the Section, intimating that the Postal Microscopical Society of Victoria proposes to forward slides for examination, and requests slides in return.

Mr. PARISS NESBIT having seconded the proposition, it was carried.

Mr. S. DIXON sent a communication respecting the supposed discovery of coal at Kangaroo Island to the effect that he was positive that it was washed up by the sea either from some vessel or very distant place.

Mr. JAMES STIRLING, F.L.S., forwarded "Notes upon a Geological Sketch Section of the Australian Alps." In 1867 he spent a long time on the southern portion of Western Australia searching for coal, and found it in every instance undoubtedly brought there by the sea, as the whole coast between Cape Arid and Doubtful Island Bay was miocene resting on granite and micaceous schists. He had been induced to make the expedition owing to the late Mr. Roe, Surveyor-General of Western Australia, reporting the existence of coal on the Fitzgerald River, and it was thought some connection might exist between the known occurrence of the bitumen and the reported beds of coal; but the supposed coal was nothing but a thin bed of brown lignite.

Digitized by Google

Ordinary Meeting, April 8, 1884.

H. T. Whittell, M.D., President, in the chair.

Ballot.—Messrs. W. L. Neale, Otto Bœttger, W. S. Scannell, and Revs. John Watson and Robert Kelly were elected Fellows, and Mr. H. Hodgson was elected an Associate.

exhibits.

Prof. Tate showed a specimen of stratified pebbles occurring in a rock at Hog Bay, and referred to in his paper upon the geology of Kangaroo Island.

Mr. J. G. O. Tepper, F.L.S., also exhibited a portion of rock from Hog Bay, showing a stratification of ironstone, with other minerals.

Mr. C. L. Wragge, F.R.G.S., laid on the table a piece of pumice stone found floating in the sea off the Straits of Sunda. The vessel passed through something like 500 miles of it.

The Rev. W. R. Fletcher, M.A., read notes respecting the Fish River Caves in New South Wales, which he had lately visited.

Prof. Tate, F.G.S., moved—"That the gossip meetings of the Royal Society and the evening meetings of the Field Naturalists' Section be held conjointly at least once a month."

Mr. Thos. D. Smeaton seconded, and the motion was carried.

Ordinary Meeting, May 6, 1884.

H. T. Whittell, M.D., President, in the chair.

exhibits.

Prof. Tate, F.G.S., showed a specimen of *Stiphelia Woodsii* from Kangaroo Island, found by Mr. J. G. O. Tepper. The only other locality previously known for it being near Penola.

Mr. J. G. O. Tepper, F.L.S., showed a woody fungus shaped like a common mushroom, with turned-up edges like a frill, from Queenscliff, K.I. Also a leathery puff-ball with a large quantity of mycelium enclosing fine sand, from Mount Lofty.

Prof. Tate, F.G.S, exhibited a living echidna obtained from near Mount Gambier, which appeared to differ from the species found upon Kangaroo Island in having a shorter snout, and in the possession of a larger quantity of black hair and soft quills.

Prof. Tate, F.G.S., elicited from the members of the Board of Governors of the Adelaide Institute present, namely, Dr. Stirling and Mr. C. Todd, C.M.G., the statement that the Board were determined to avail themselves of the assistance of Australian scientific specialists in the work of classifying the zoological specimens at the South Australian Museum whenever possible.

Digitized by Google

Mr. C. L. Wragge, F.R.G.S., read a paper on the probable causation of the phenomena of the red glow after sunset.

Ordinary Meeting, June 3, 1884.

H. T. Whittell, M.D., President, in the chair.

Ballot.—Mr. E. Spiller was elected a Fellow.

EXHIBITS.

Prof. Tate, F.G.S., laid on the table a specimen of wulfenite (molybdate of lead) found near Quorn; a piece of plumbago from Mount Charles, Onkaparinga; a *Scirpus littoralis* found on the banks of the Torrens Lake; and some basalt containing in cavities some crystals, probably of arragonite and hyalite, from Mount Gambier.

Mr. J. G. O. Tepper, F.L.S., showed a mass of brown mycelium of a leathery texture, found in the heart-wood of a decaying eucalypt.

Prof. Tate, F.G.S., read the first part of a paper entitled a "Study of the Lower Murray."

Ordinary Meeting, July 8, 1884.

H. T. Whittell, M.D., President, in the chair.

Ballot.—Mr. P. O'Leary, M.R.C.S., England, was elected a Fellow.

EXHIBITS.

Mr. J. G. O. Tepper, F.L.S., showed a stipa, supposed to be *semibarbata*, from near Mount Lofty; a curious fibrous growth from beneath the bark of *Banksia marginata*.

Mr. E. Meyrick, B.A., forwarded a list of 180 micro-lepidoptera seen by him during a recent visit to South Australia.

Prof. Tate, F.G.S., read the second portion of his "Study of the Lower Murray."

Mr. J. G. O. Tepper, F.L.S., presented a paper giving particulars concerning a number of plants observed by him during a recent visit to the eastern end of Kangaroo Island.

Ordinary Meeting, August 5, 1884.

H. T. Whittell, M.D., President, in the chair.

The President mentioned that an invitation had been received from the American Academy of Sciences to appoint a delegate to attend a Science Congress at Philadelphia on September 3rd, 1884. It would be too late to send a delegate, but if any South Australian colonist was known to be travelling in that direction, it would be possible to appoint him by telegraph to attend as the representative of the Society.

Digitized by Google

Mr. C. H. Harris read a paper on "Variations of the Compass in South Australia, with some remarks on Terrestrial Magnetism."

Ordinary Meeting, September 2, 1884.

H. T. Whittell, M.D., President, in the chair.

EXHIBITS.

William Haacke, Ph.D., showed an albino specimen of the grass paroquet—*Euphenia multicolor*—the colour of the general plumage being changed into sulphur yellow; the colour of forehead, neck, shoulders, and rump changed into bright red. Also a new medusa of St. Vincent Gulf, and several specifically different *Idolea* from the same waters. Also an ovum found in the pouch of a female echidna, proving that the echidna, although a milk-giving animal, lays eggs which are hatched in the pouch.

Mr. W. A. Jones read a paper on the "Red Glow," advocating the aqueous theory of its formation.

Mr. Lionel Gee, C.E., was elected an Auditor for the current year.

Annual Meeting, October 7, 1884.

H. T. Whittell, M.D., President, in the chair.

Ballot.—Messrs. A. G. Abbott, George Gill, and F. Wheeler were elected Fellows.

Due notice having been given, it was proposed, seconded, and carried—"That Rule 38 be altered by the substitution of the words 'Public Library, Museum, and Art Gallery' in place of 'South Australian Institute.'"

The alteration of Rule 37, made at a meeting held November 6th, 1883, was also approved.

EXHIBITS.

Mr. H. C. Mais, M.I.C.E., showed photographs of sections of wood taken in the United States of America.

W. Haacke, Ph.D., exhibited two photographs and dissections of a female *Echidna hystrix*, in the pouch of which he had found the ovum shown at the last meeting. There was only one large pouch, not two small semicircular fossæ, as seen by Professor Owen. The large pouch evidently acted as an incubator for the ovum, and probably disappeared after the hatching of the young, only two small semilunar fossæ being left. He pointed out also that his specimen showed small tufts of hair on the mammary areola, now discovered by him in several male echidnæ, which on being dissected were found to possess unmistakeable rudimentary milk glands, thus showing that the generally adopted

Digitized by Google

belief that such glands were missing in the male monotremata was discredited by facts.

Mr. A. MOLINEUX remarked that he had observed that many of the shark tribe, and especially the *Cestracion* (Port Jackson shark), exuded blood from the skin of the abdomen and on the edges of the fins when dying, and that this occurs even when every precaution is taken to prevent the fish from injuring itself after capture.

Prof. TATE forwarded papers on the "Lamellibranchs of the Older Tertiary of South Australia;" "Description of New Species of Plants in South Australia;" "Additions to the Flora of Extra-Tropical South Australia;" and "Miscellaneous Botanical Notes."

The HON. SECRETARY read the Annual Report as follows:—

ANNUAL REPORT.

The Council has the honour of reporting that the work of the Society has been carried on successfully during the past year, the following papers having been laid before it:—"The persistence of Electric Currents in Masses of Iron," by Prof. Lamb, M.A.; "Notes upon Two Rare Insects," by J. G. O. Tepper, F.L.S.; "Some Algæ of Gulf St. Vincent," by J. G. O. Tepper, F.L.S.; "Some New Medusæ of Gulf St. Vincent," by W. Haacke, Ph.D.; "The Fish River Caves of New South Wales," by the Rev. W. R. Fletcher, M.A.; "The Red Glow," by C. L. Wragge, F.R.G.S.; "Microlepidoptera of South Australia," by E. Meyrick, M.A.; "A Study of the Lower Murray," by Prof. Tate, F.G.S.; "Plants of Kangaroo Island," by J. G. O. Tepper, F.L.S.; "Conspectus Familiarum of Foreign Coleoptera at the S. A. Museum," by J. G. O. Tepper, F.L.S.; "Variations of the Compass in South Australia," by C. H. Harris; "Action of Carbonated Water on Iron Pipes near Gawler," by G. Goyder, jun.; "Remarks on Pons-Brooks and Ross Comets," by C. Todd, C.M.G.; "The Electrical Water-Level Indicator," by C. Todd, C.M.G.; "The Ovum of the Echidna," by W. Haacke, Ph.D.; "The Red Glow," by W. A. Jones; "The Lamellibranchs of the Older Tertiary of South Australia," by Prof. Tate, F.G.S.; "Description of New Species of Plants in South Australia," by Prof. Tate, F.G.S.; "Additions to the Flora of Extra-Tropical South Australia; and Miscellaneous Botanical Notes," by Prof. Tate, F.G.S.

The exhibits have fully sustained the character of those of previous years by their variety and value. At a meeting held September 2nd, 1884, Dr. Haacke exhibited the ovum of an echidna which he had obtained from the pouch of a living specimen in his possession. A special interest to the whole

Digitized by Google

scientific world attaches to this, as it is the first recorded exhibition of such an ovum before any scientific society, and Dr. Haacke may fairly claim a priority in the actual demonstration of the oviparous character of the birth of the echidna.

The membership of the Society consists of 126 Fellows, 12 Hon. Fellows, 14 Corresponding Members, two Life Members, and three Associates, making an increase of eight since last year. Several names have been removed from the roll, on account of death and other causes, so that the actual increase is small, although the nominations and elections during the year compare favourably with that of former ones. Amongst other deaths, your Council would specially refer to that of Mr. C. A. Wilson, who had been a Fellow of the Society for more than thirty years. During the earlier period of his membership he devoted himself with great zeal and devotion to the pursuit of natural history, confining his attention chiefly to the varieties of the Coleoptera with which the colony abounds. He always took a great interest in the affairs of the Society, and was ever a leading member, until of late years his continually-increasing ill-health obliged him to retire more into private life.

Since the last annual meeting the Field Naturalists' Section has become an accomplished fact, and from the large number of members on its roll the Council hopes that it has in this way met a popular want, and that a valuable nursery has been started, whence the Society may ultimately receive a supply of working Fellows. To further the object aimed at by the Section, the Council has during the year paid to it a grant of £10 to meet preliminary expenses.

A radical change in the constitution of what was formerly the Adelaide Institute has necessitated a corresponding change in the relations of the Society to that body—the Society no longer being incorporated with it. In future it will stand in the position of an affiliated Society to the Public Library, Museum, and Art Gallery of South Australia. The rapid increase in the School of Design, &c., &c., has necessitated the Society removing from the old room into a more commodious place in the new wing of the Museum. During the transition from the one place to the other the Council of the Adelaide University very generously put one of its lecture-rooms at the disposal of the Society, for which the warmest thanks of your Council are due.

During the past year a request has been received from the Librarian of the Public Library, Museum, &c., for a large increase in the number of the Society's Proceedings supplied (150), which your Council feels flattered in thinking indicates an increased appreciation of the work performed by the Society. The list of foreign exchanges is also ever on the

Digitized by Google

increase, and amongst others is now included the Royal Society, London.

A postal microscopical exchange has also been established with the other colonies, which, it is to be hoped, will stimulate the Fellows to the formation of a section for microscopic work which shall emulate the original work now done in the natural science domains of the Society.

It being felt that many of the Fellows would appreciate some systematic teaching in natural science, it was resolved to hold the gossip meetings and the evening meetings of the Field Naturalist Section conjointly; and from the large attendance your Council has every reason to be satisfied with the result.

Owing to our representative on the Board of Governors (Mr. Todd) having been chosen as one of the Government members under the new Act, it has been necessary for the Council to elect a substitute. The decision fell upon Dr. Whittell, and his election must afford every gratification to the Fellows and Members.

Your Council has very reluctantly had to accept Prof. Tate's resignation of his seat on the Council, with its attendant offices. During Prof. Tate's connection with the Council he has devoted himself to the Society with an enthusiasm and devotion that has raised the Society from the status of a Literary Club to the distinguished position of a Scientific Society, and has made its 'Proceedings sought after by other scientific bodies eager for the acquisition of new facts in natural science. The very arduous duty remains for you to fill his place with a suitable occupant.

To make the Council more representative of the various branches of science contained in the Society the number of members of Council has been increased from four to six.

During the year a number of valuable works of reference and monographs have been received.

The financial statement was then made, and showed that the receipts during the year had been £269 17s. 6d., and the expenditure £229 13s. 4d. The balance in the Bank was £64 19s. 7d., and £250 was placed on deposit.

On the motion of Mr. S. Tomkinson the report aud balance-sheet were adopted.

The report of the Field Naturalists' Section was received, and appears elsewhere.

The PRESIDENT (H. T. Whittell, M.D.) then delivered his address.

Digitized by Google

PRESIDENT'S ADDRESS.

It is a time honoured custom for the President of a Society which has for its object the promotion of science to deliver at the close of his year of office an address, in which it is expected that he will give a brief review of the Society's operations during the year that has passed, and also bring under notice some one or other of the more prominent inquiries to which his attention may have been specially directed.

The report which our Secretary has just read gives a short but accurate account of the year's proceedings. One of the more important of these has been the formation of the Field Naturalists' Association as a Section of this Society. That Section owes its origin to a desire expressed by a number of young men—perhaps I should be right if I were to say of young women also—to band themselves together for the purpose of mutual assistance in the practical study of the more elementary branches of natural science. The Section has been well looked after by its Secretary, Mr. Pickels, and it has had the advantage of having Professor Tate for its guide and instructor. A more capable man for this work does not exist in the Australian colonies. It is no wonder that the Section has succeeded, for with such a leader failure would be scarcely possible. And this reference to the learned Professor reminds me that what the Field Naturalists' Section has gained the parent Society has lost. The report just read has informed you that Professor Tate, after many years of efficient work on our behalf, has resigned his position and offices in connection with the Council, and has left a gap in our ranks which all of us know too well will be difficult to fill. I can but emphasize the regret expressed by the Council that the Professor has felt it necessary to retire.

During the year we have been favoured with papers on a variety of interesting subjects by members and gentlemen who take an interest in our Society. Among the contributors I may mention Professor Lamb, Professor Tate, Mr. Meyrick, the Rev. W. R. Fletcher, Dr. Haacke, Messrs. Wragge, Harris, Jones, Tepper, and Todd, some of whom have on more thay one occasion placed us under obligation. But undoubtedle the most memorable event in our year's proceedings, will be that which gives to our Society the proud boast of being the first at which the discovery was announced, by one of our own Fellows, (Dr. Haacke) that the echidna—one of the lowest types of mammalia—is oviparous, and is one of the long-sought-for connecting links between mammals and the lower classes of vertebrata. It is not my purpose to-night to discuss

Digitized by Google

the views of evolutionists on the one hand or of believers in special creation on the other. Doubtless most of us have arrived at conclusions on these subjects; but whatever those conclusions may be, we shall all be ready to welcome a discovery which will leave through all time a broad mark on the historical records of scientific research, and confer lasting honours on those who have been engaged in bringing it to light. Most of us know that another naturalist announced almost simultaneously his independent discovery of the same fact. We are not at present informed when Mr. Caldwell arrived at his conclusion; but without wishing to withhold for one moment any portion of the honour that is due to him, I claim for Dr. Haacke priority as being the first to announce publicly his discovery, and the first to exhibit at a meeting of a scientific Society the egg taken from the pouch of the echidna, by which he was enabled to demonstrate the accuracy of his observations. I venture on behalf of this Society to offer to our learned *confrere* our warmest congratulations. Some credit, too, is due to our assistant Secretary (Mr. Molineux), who has been at work for some months in obtaining specimens from Kangaroo Island with the view of enabling naturalists in Adelaide to pursue their investigations.

I propose in the present address to bring under your notice the influence of micro-organisms in the production and propagation of that class of diseases which are of an infectious nature, or—to use the old-fashioned but not less expressive word of our grandmothers—which are "catching." Most members of this Society will be familiar with the fact that various animal parasites of a low type are known to live and grow in animals of a much higher organization. The papers read before the Society by Dr. Thomas on Hydatids, and by Dr. Mann on the Blood Filaria, have informed us of the destructive effects of these parasites in the internal organs of their host. In these cases we have to do with organisms of comparatively large size. You will also remember that many vegetable parasites exist and destroy living tissues, each after its own peculiar fashion. We find *sarcina* in the stomach, *oidium albicans* in the mouth, and *trichophyton tonsurans* in ringworm of the scalp and elsewhere. These, too—although the last one will split a hair till it resembles a crossing-sweeper's broom—are comparatively large, their effects are chiefly local, and they do not produce constitutional disturbance. Some of these, however, manifest a characteristic which, in the still lower organisms, is more distinctly marked. They have the property of infection. Every schoolmaster is familiar with this in the plague of ringworm so troublesome at times in our larger schools. Passing from these to organisms which are more

Digitized by Google

minute, and probably of a lower type, I shall ask you to note for a few moments one or two simple experiments, which, although made on non-living material, will prepare the way for further study.

If we take any kind of organic matter—whether animal or vegetable is of no consequence—and place it in water and expose it to the air at a moderate temperature we shall see after a day or two a very thin pellicle floating on the surface. If we examine a small portion of this under a moderately high power we shall find that for the most part it consists of minute spherical or rod-shaped bodies, many of which from their peculiar gliding or undulating movements we know to be alive. If we watch them for a sufficient time we shall get further evidence of their vitality by seeing them grow, divide, and multiply. If we repeat our experiment with different materials and under varied conditions we shall find that, although the living bodies that grow in our solutions have a strong family likeness, there are differences in shape and in mode of motion which enable us to attempt some form of classification. Some of them look like simple round points; some are more rod-shaped; while others, again, are long and narrow. Some appear to be quite motionless; others glide slowly along from one side of the field to the other; while others, still, will be seen to wriggle with a spiral corkscrew kind of motion from point to point. It's a busy world we are looking at. We shall see, further, that, although all of them are minute, there are considerable differences in size, some of them being many times larger than others. If we try to obtain with the highest powers at our disposal a more intimate knowledge of their organization we find them exceedingly simple in structure—in fact, they appear to be nothing more than minute masses of protoplasm, which are probably enclosed in a cell membrane. For a long time they were supposed to belong to the animal kingdom, and their movements gave some support to this view; but in later times most observers place them in the lower orders of plants, some botanists classifying them as algæ, while others with perhaps more reason assign them to the fungi. In the French school they are commonly known as *les microbes*. In England they are more frequently included under the common term Bacteria. In one form or another they exist everywhere—in the air, in the water, and in the soil. As to their origin, there has been much contention. Some observers have gone so far as to maintain that they originate by self-generation, while others more cautious and more numerous concur with Pasteur and Tyndall that wherever we find them they owe their existence to previously existing germs, which in different modes have found their way into the fluid or structures in which they are discovered.

Digitized by Google

If we had taken the organic fluid used in the experiment already noted, and if instead of exposing it to the air we had put it into a small flask, and after boiling it for some time we had hermetically sealed up the mouth of the flask or had put into its neck a stopper of baked cotton wadding, it is probable that the fluid would have remained unchanged for an indefinite time. The boiling would kill all the Bacteria in the fluid, and the cotton would prevent the entrance of any fresh organisms from the air. If we had repeated the boiling for a few days in succession the probability would be reduced to certainty, assuming of course that all the necessary precautions were taken. A fluid so prepared is said to be sterilized, and may be used as a culture fluid for the growth of Bacteria. If we pass into it an infinitesimal quantity of a liquid containing any special form of bacterium, the bacterium will grow and multiply, chiefly by fission, and will commonly also form minute refractive granules, which in process of time will be liberated from the containing cell and fall to the bottom of the flask. These granules or spores are the seed from which new growths of Bacteria exactly like the original stock can be readily started. And just as we find it easy to kill young plants by cold or heat or injury, although the seed of such plants will bear all kinds of rough usage without harm, so, although fully developed Bacteria can be easily killed by heat and other means, the spores are almost indestructible. Germicides have but little effect on them. Alcohol will not kill them, and they have been known to germinate even after from eight to ten hours boiling.

We have seen that there are differences in form and size among the Bacteria. It is probable there are numerous varieties of species, and even of genera, which the best microscopes yet provided will not enable us to distinguish sharply one from another. We can form some opinion of this by the differences in the changes they produce in the fluids or substances in which they flourish. Some of them are probably harmless enough, but we have knowledge of many which are highly destructive, and which even produce powerful poisons in solids and liquids brought under their influence. I need only remind you of the change of the sugar of grape juice into alcohol by the action of one form of these organisms, of the conversion of alcohol into acetic acid by another form, and of the change of one of the constituents of milk into lactic acid by another form. The Bacteria, though invisible, are always working, playing, even in their destructiveness, an essential part in the progressive alternations of organic life.

We have as yet noticed the Bacteria in their relation to dead organic matter only, but we must now approach the

Digitized by Google

question: Have these organisms any existence in the living body, and, if so, have they any special role either in health or disease? This is a question easier to ask than to answer. We are liable to errors, both of observation and of interpretation; but, so far as our best observers, aided by the most perfect microscopical appliances at command, have been able to learn, there is a general agreement—(1) That Bacteria do not exist in the fluids or tissues of an animal in health; (2) that in some diseased conditions, and particularly in diseases of an infectious nature, Bacteria can, as a rule, be found in abundance; (3) that in some of these diseases the Bacteria can be distinguished one from another by special modes of observation; (4) that they can be further distinguished by culture in sterilized fluids; (5) that the Bacteria cultivated in such fluids have the property of communicating a disease to healthy animals exactly resembling that affecting the animal from which the infecting material was obtained; and (6) that it is possible by modes of culture, and other means, to modify the virulence of some of the most dangerous Bacteria to such a degree that when fluid containing them is inoculated into a healthy animal it produces but a slight temporary effect, but sufficient to protect the animal for an indefinite period from further infection. These are the revelations of modern science. Let it be understood that I do not claim that all these points have been ascertained with respect to all infectious diseases. There is no need to overstate the case. I shall hope to show you that in some of these diseases the facts are established beyond a doubt, and that reasoning by analogy we are justified in the inference that what is true of some is probably true of the whole class.

Time will not permit me to take up the several points I have enumerated in regular series. I prefer, therefore, to discuss them generally; but before doing so I ask you to allow me to introduce a lesson in microscopical technology, for the want of which many well-meaning observers have fallen into errors. Many of the objects we are dealing with are so extremely minute that when magnified under glasses, which give distinct images of objects magnified in the proportion of an inch square to a square of 50 yards, do not appear larger than pins' heads, and even when so magnified would probably be invisible if not stained by a process perfected by Koch in his researches on infectious diseases. Objects so minute require special methods of examination, and I think Koch and workers of like rank are justified in refusing to notice the objections of less practised observers, who have neglected to follow the special means which they believe to be essential for successful demonstration. Koch insists on the use of oil immersion lenses, of

Digitized by Google

high angle, and in the use of a powerful substage condenser (Abbe's), used without any diaphragm, so that the object shall be lighted up by an intense glare of light. I must confess that when I first heard of this mode of showing stained Bacteria I felt that if anyone had asked me "How not to do it?" I should probably have suggested some such mode of illumination. A practised microscopist is very fussy about his illumination: he works with but little light—just sufficient to bring out details, and no more. He stops out the light by diaphragms. Dallinger's best work was done under an illumination in which all the light passed through a mere pinhole, and I have no doubt that many microscopists have been deterred from following Koch's directions by a desire to preserve the details of the picture, all of which are lost under strong illumination. But on further study we find that this is the great object Koch has in view. Finding in practice that Bacteria stain much deeper than other structures in aniline dyes, he reasoned that if all the objects that are less deeply stained could be blotted out, or rather, dazzled out of the picture, and nothing remain in view but the darker colour picture of the deep-stained Bacteria and a few other objects not likely to be mistaken for them, it would be possible to distinguish these, although in a less illumined field they could not be picked out from other objects in view. General experience has proved that he is right.

I shall not ask you to burden your memories with the tiresome details of classification, but it is necessary for our purpose that we bear in mind that in disease there are at least four distinct forms of Bacteria to be recognised—(1) There is the minute rounded body—the micrococcus, existing either separately or in chains; (2) the short cylindrical cell—the bacterium proper; (3) the longer and more filamentous cylindrical cells, either isolated or in chains—the bacillus; and (4) spiral undulating filaments—the vibrio and spirillum. It is probable that in their stages of development some of these pass through different forms; but our knowledge on this subject is incomplete. In bringing to your notice the association of some of these bodies with disease we will begin with one of the most simple.

Let us take a common acute abscess. Dr. Odgston shall be our guide. This gentleman found that a small drop of matter from an acute abscess, when dried on a slide, stained and observed after Koch's method, presents to view an immense number of micrococci scattered about the field. When a minute portion of such matter was inoculated into a second and healthy animal, abscesses formed in this second subject, and the pus in these was also loaded with micrococci. A third animal inoculated from the second showed the same results, and

Digitized by Google

in this way the disease could be passed on from animal to animal through an indefinite series. In some animals the cocci were found in the blood, and when this was the case well-marked constitutional disturbance was observed. There are some forms of abscesses known as cold chronic abscesses, which do not contain cocci, and in twenty inoculations with matter from these Odgston failed to develop either an abscess or constitutional disturbance. There is, therefore, an obvious connection between the micrococci and the infective properties of the pus. But Odgston carried his experiments further; he cultivated the micrococci outside the body. He made a small hole in an egg, and by suitable means he introduced a drop of pus from an acute abscess into the end farthest from the hole. He covered the opening with antiseptic dressing, and kept the egg in an incubator at 98° temperature during ten days. The egg remained sweet and fresh, but chains of micrococci were found in the albumen. A drop of this albumen was injected into an animal's back. An abscess was formed, and numerous micrococci were found in the pus, and also in the blood of the animal. These experiments were repeated, and varied by inoculating a second egg from the first, and after inoculation of an animal from this egg the same results were observed as in the first experiment.

Let us turn to another example—one of a more complicated character. It has been known from the earliest history of medicine that the injection into the tissues of a healthy body of a small quantity of putrid matter is usually followed by alarming and sometimes fatal consequences. Sometimes the animal dies in a few hours; in other cases there is a stage of incubation, in which no symptoms show themselves. Then comes fever, and after this either recovery or death. The chemists and biologists have discovered that in putrid matter there is a chemical compound (sepsin) which is an active poison, and also numerous Bacteria. When an animal dies a few hours after inoculation, he dies with symptoms of poisoning, and no abnormal growths are found in the blood or tissues. But if the animal escape the action of the poison, and dies afterwards in the second mode I have described, then we find Bacteria in most parts of the body. Koch's experiments on mice will serve as an illustration. Koch injected five drops of putrid blood into mice, and the animals died in from four to eight hours. No Bacteria could be found in the blood, nor did the fresh blood of the poisoned mouse produce any effect when injected into another mouse. If a smaller quantity of the putrid blood were injected the effects were different. Some mice escaped without injury, but others became ill and died in from two to three days. Now mark the difference. The blood of these

Digitized by Google

mice was infectious, and the disease could be transmitted from one mouse to another even with only the tenth of a drop of blood. Koch carried this on through seventeen successive inoculations, and always with the same results. He inferred that the mice were killed by a micro-organism, but for a long time his closest scrutiny failed to discover it. At last, after prolonged search and the adoption of the mode of observation I have previously described, he discovered in the blood of these mice an immense number of bacilli, which were so minute as to escape detection under all the ordinary modes of examination. So long as these could be found in the blood, so long was the blood infectious; but so soon as they disappeared the blood could be injected into another animal without risk. And here we may notice a curious fact, which is probably true of all the infective Bacteria—each species appears to have its own favourite *habitat*. They flourish in some species of animals, but die or have no effect in others. Thus Koch found that if he inoculated a field mouse instead of a house mouse with infected blood the animal was not susceptible. I am not unmindful that objections have been frequently urged against the conclusions drawn from experiments of this kind on the ground that the Bacteria in these cases are the accidental products of other changes, and not the cause of the abnormal conditions in which they exist. I shall therefore bespeak your patient attention to another infectious disease, in which the life history of a rather large form of bacillus has been so thoroughly worked out by Davaine and Pasteur in France, Koch and others in Germany, and Klein in England, as to leave no room for such objections. I refer to a disease known under many names, but more commonly as charbon anthrax, splenic fever, or malignant pustule. Long before bacteria were thought of, all the world knew that anthrax was infectious from animal to animal, and in some cases from animal to man. In some Continental districts it has caused terrible destruction of cattle and sheep. In England it is less prevalent, but many workmen woolsorters and workers on skins have fallen victims to it. Twenty years ago its cause was unknown. All sorts of theories were invented to account for its existence. Of course climatic influence, weakness of system, faulty secretions, bad diet, damp pasturage, and all the other thousand and one makeshifts for covering ignorance were made to do duty. At length Davaine, attracted by some experiments of Pasteur, turned his attention to anthrax, and discovered that in the bodies of animals, dead from the disease, there exists rather large forms of bacillus, which appeared to him to be different from the ordinary micro-organisms found in putrefaction. He was not long before

Digitized by Google

he found that this bacillus could be inoculated from one animal to another, and that the inoculated animal became affected with anthrax, like the one from which the inoculating material had been obtained. On these facts he based his theory that the bacillus is the cause of the disease. There is in science, as in politics, a good old Toryism, with a mission of obstruction. It is a poor mission at best, but doubtless in the evolution of truth it has its uses. The use it served with respect to this new theory of anthrax was to set many inquirers earnestly to work in many lands until one by one objections have been silenced, and it is doubtful whether to-day any pathologist of any pretentions would question the correctness of Davaine's conclusions. Let us look at the facts. Not only can the disease be communicated by inoculation from animal to animal, but the bacillus can be cultivated almost indefinitely. If a drop of anthrax blood be put into one of the sterilized flasks and maintained at blood temperature the bacillus will grow in profusion for several days. A drop taken from this flask will set going new growths in a second one, and a drop from this will start a third, and so on, down to the fiftieth, or even the hundredth generation, and yet a drop from the last culture will as certainly produce anthrax after inoculation as if the original drop of blood were the infecting agent.

In experiments on the anthrax bacilli many other interesting facts have been brought to light. The development of the spores and their resisting power against destructive agents have been well studied. It has been ascertained that these spores are not formed in the bodies of living animals, nor will the anthrax grow in a dead animal unless atmospheric air be present. The same applies to the bacillus under cultivation. Pasteur found that without air the organism does not flourish. Klein confirms this by experiments that show that in the upper stratum of a culture liquid abundant spores are formed, while the rods and filaments lower down, being more removed from the air, remain sporeless. Pasteur found, further, that temperature has a marked influence on the growth, and he reports a curious fact that in chickens, with their blood at the normal temperature—which as you remember is higher than in sheep—anthrax will not develop, but if the temperature be reduced two or three degrees by placing the lower part of the body in cold water the bacillus will flourish. If a chicken in which anthrax has been thus developed be warmed the disease will be cured. So, again, if a sheep or a cow recover from anthrax the animal is proof against further attack. Another curious experiment has been reported, that rats fed on animal food are proof against anthrax, while those fed on vegetable

Digitized by Google

food quickly succumb. These are gatherings by the way from which some day we may hope to obtain practical advantages.

We may here inquire how does the anthrax bacillus kill? So far as we can learn, it acts partly by depriving the blood of its oxygen, partly by blocking up the minute vessels of important organs, and partly by forming poisons in some of the fluids of the body, analagous to what occurs in the production of alcohol from sugar. It will therefore be understood that the symptoms are of a mixed character. A glance at them as they occur in man will serve as a type of what is seen in most acute infectious diseases. The symptoms may be either local or general. In the local symptoms there is destruction of the part affected. The general symptoms have been so well described by Mr. Spears in his report to the Local Government Board on the Bradford wool-sorter's disease, that I ask your attention to a condensed account. Mr. Spears says, the course of the disease is devisible into stages. At first we have the stage of incubation; next the stage of invasion; next the acute and stormy manifestations; next, unless the patient die, the stage of recovery, followed in some cases by secondary inflammatory action. The duration of incubation could not be accurately determined. In the stage of invasion there were chilliness, great bodily weariness, and mental depression, sometimes perspirations, restlessness, sighing, yawning, aching of the limbs, dizziness, nausea, and sometimes vomiting. After a few days the sufferer suddenly becomes worse, the prostration and restlessness are more marked, the respiration is accelerated, the pulse rises to between 100 and 140 per minute, the temperature becomes variable, and as the disease progresses there may be higher fever with a temperature of 104° or 105°, with a tendency to irregular downfalls. Then come violent headache, incessant vomiting, occasional delirium, together with signs of local congestions, followed in bad cases by death, sometimes from prostration and sometimes from profound coma. Many patients in Bradford suffered from this obscure fever. The workmen suspected a certain kind of wool—the mohair from the Van district in Asia Minor—and at some of the mills they adopted the plan of drawing lots to determine who should work this kind of wool. At the time of Mr. Spears' visit a sample could not be obtained, but evidence was forthcoming from other sources. The tissues of the patients who died were examined by Dr. Greenfield at the Brown Institute, and whole colonies of the anthrax bacilli were discovered. The inoculation of animals with these bacilli or with cultivations from them produced anthrax in the animals operated on. Besides this it occurred that about the time the workmen complained, the animals on a sewage farm on which the suds from

Digitized by Google

the washing of the mohair had been distributed sickened with anthrax and died in numbers.

The evidence adduced proves that there is at least one infectious disease which owes its origin to the growth and development of micro-organisms within the body of its victim, and to this cause only. And if this be true of one, why may it not be true of others which, like it, are infectious, have their stages of incubation, full development, and of retrogression, show marked febrile symptoms, seldom occur more than once in the same patient, and present in their tissues, in many examples, peculiar forms of micro-organic growths? Why, in fact, may we not infer that every infectious disorder owes its origin to its own peculiar organism? Grant, if you will, that we are in the region of hypothesis; but in the absence of other satisfactory explanations it is reasonable to adopt the one which covers a larger number of facts than any other, and which every new discovery tends to confirm.

The evidence does not rest, however, on the form of disease. There are some diseases of animals in which the facts are almost as well worked out as in anthrax. There is also a fever which attacks man, and known as relapsing fever, in which one of the spiral Bacteria (the Spirochœte Obermeieri) is always found in the blood when the fever is at its height, and disappears as the fever declines. Monkeys have been successfully inoculated with this bacterium, and have taken the fever; and it is asserted that the same results have followed in the human subject after inoculation with blood taken from a patient while the fever was high, and that no effect was produced with blood taken from the same patient when no fever was present.

In nearly all the acute infectious diseases Bacteria in some form are to be found, and cultures can be obtained from them. In measles, diphtheria, erysipelas, smallpox, vaccine lymph, and, as I have lately found, in the hybrid chicken-pox, various forms have been discovered. The history of these is not worked out. So also in typhoid fever—with which we are all too familiar—Koch's assistants at the German Board of Health announced last year the discovery of a peculiar organism which they believed to be its cause. During the last few months I have been making independent researches, and all my investigations point in this direction. And let me note that the clinical history of the disease favours the germ theory of its origin, even though no specific organism can be fixed on as its starting point. Typhoid has been carefully followed up and investigated by Government medical officers in England, and there is a uniform agreement that this fever is a disease associated with the filth of human excreta. There is strong evidence that this excreta

Digitized by Google

is only infective when mixed with some of the secretions of a patient already affected. This accounts for persons being affected from drinking water from wells into which there is soakage from closets, or from a reservoir polluted by sewage, or from drinking milk supplied from some distant dairy where patients are suffering. Here in Adelaide, only a few months ago, the Central Board of Health traced twenty-three cases of typhoid to a dairy where a child was ill with the disease. In all these instances there must have been something capable of infecting the water or the milk, and this must have been something having the property of growing and increasing in the medium in which it existed. If this be not a micro-organism I must leave it to others to determine its nature. We are all interested in the discovery of the causes of that devastating malady—cholera—which now and again sweeps across Europe like a plague from its Indian home. Our newspapers have told us that the German Government sent Koch to Egypt, and afterwards to India, to investigate this disease. It is humiliating that a foreign Government should undertake a work which England ought long ago to have taken in hand; but we are none the less thankful for the light which Koch's observations have thrown on this disease. These observations have led to the discovery of a bacillus in the intestines of cholera patients which sufficiently differs in shape from others, as in Koch's opinion, to be distinguishable. It is thicker at one end than at the other, and being curved resembles a comma. Hence it is called the comma bacillus. The same bacillus was found in a tank from which the patients had drawn their supply of water. It could be cultivated like the other Bacteria, but for obvious reasons it could not be experimented with on human beings, and as cholera is not a disease of the lower animals the crucial test is not available. Koch found that this bacillus has a peculiar mode of development under cultivation; it has not been observed to form spores, and it is easily killed by absence of moisture. Supposing them to be the cause of cholera, we have the consolation of knowing that if they once become dry there is no further danger. Koch has given demonstrations before a Commission in the South of France, and this Commission confirms most of Koch's conclusions. Our British Government has lately sent Klein and Gibbes to India to make further investigations, and we await with more than ordinary expectation the result of their work.

There is another discovery of Koch's which has an interest in every part of the world where consumption or tuberculosis is known. Ever since I can remember there has been a suspicion in the medical mind that consumption is sometimes infectious. Within the last few years our German *confrère* dis-

Digitized by Google

covered the existence of a bacillus in tubercular matter, which can be distinguished from all other micro-organisms, except that of leprosy, by its retention of aniline dye when submitted to processes which discharge the colour from other Bacteria. This bacillus can be cultivated, and if a drop of the culture fluid is inoculated into animals they soon succumb, and tubercle is found in all parts of their internal organs. These observations have been repeated all over the world, and the fact may now be considered as established. I can but hint at the great changes which this discovery must bring about in the diagnosis and treatment of tubercular disorders. I shall have an opportunity presently of showing you a group of these bacilli found in a particle of expectoration from a consumptive patient in the Adelaide Hospital. The demonstration will be made after Koch's method, and with the illumination he so strongly insists on.

We must hasten on. What will be the practical issue of these discoveries? If it be established that every infectious disease has its own peculiar germ on which its existence depends, we have gained for the first time in the history of medicine a clue to these diseases. We get rid of the fogs of speculation and come into the light. We know at least in what direction to work in order to stamp out the enemy. Already some promise of this is being given. I was a member of the International Medical Congress in London when Pasteur startled us with the announcement that he had discovered and put to the test methods of attenuating the virus of more than one infectious disease, whereby he could safely vaccinate—as he chose to call it—animals so as to protect them from future attack. The evidence he adduced was based chiefly on experiments with the bacilli of anthrax. He had found that the bacillus ceased to grow in sterilized liquids at about 112°, although the cultivation was easy at about 107°. At this latter temperature no spores are produced. By regulating the time as well as the temperatures he obtained bacilli with different degrees of virulence, and vaccination with the lower degree protected animals from infection by the higher. At length he obtained an attenuated virus which could be safely used for protective purposes. This was an important discovery for France, where it is stated more than twenty million ("plus de vingt millions d'animaux") animals are affected with anthrax annually. The first experiment was made on fifty sheep—twenty-five were vaccinated and the other twenty-five not vaccinated. A fortnight after the vaccination all of them were inoculated with anthrax virus—the twenty-five vaccinated sheep escaped, the other twenty-five died. The success of the experiment was so marked that Pasteur and his assistants vaccinated in the

Digitized by Google

departments near to Paris, in a fortnight, 20,000 sheep and a large number of cattle. There is no reason to doubt Pasteur's success in these experiments. It is, however, to be regretted that other experimenters, and particularly Klein in England, have not met with the same success in their attempt to follow Pasteur's mode of preparing his attenuations, nor have the attenuations prepared by Pasteur himself proved in Klein's hands to be so protective as was at first anticipated. It has been suggested that there are conditions necessary to certain success which even the great French chemist has not quite mastered; but that there is a basis on which to work no one who listened to Pasteur's address can doubt. I may mention here a remarkable discovery of Klein's, made while engaged on his anthrax experiments. This observer found that although he failed to confirm Pasteur's results, he could protect sheep against virulent anthrax by passing the virus through a mouse. If the blood of a mouse dead from anthrax were inoculated into a sheep there was a slight rise of temperature, but no further development of disease; and some sheep thus treated, and afterwards inoculated with strong virus four times in succession, remained free from harm. This is analogous to the attenuation of smallpox virus by the inoculation of a cow—a discovery by Jenner—which in our own times has done more for the human race than any other discovery of modern times. Is it not probable that what is true of smallpox and of anthrax may be true of all the other infectious diseases, and that steady research may enable us to attenuate the virus of all of them so as to obtain complete immunity? The tendency of discovery is in this direction. Pasteur is again to the front. Only a mail or two ago we got intelligence that after some four years' work he was able to announce that he had succeeded in attenuating the virus of that most intractable and most horrible of all infectious diseases hydrophobia, and that with this attenuated virus he could prevent animals bitten by rabid dogs being infected. He demonstrated this before a Commission in France by experiments on 38 dogs. Of these 19 were vaccinated with the attenuated virus, and all of them were shown to be proof against infection. Of the other 19 not vaccinated, six were bitten by rabid dogs, and three of them became mad; and of the others inoculated by injection of virus all became mad except two. The mode of attenuating the virus in these experiments is different from that employed in anthrax. It resembles that of Jenner for smallpox, and of Klein for anthrax. Pasteur found that the virus passed through some animals—rabbits and guinea pigs—increased in virulence, but on its being passed through monkeys it became

Digitized by Google

gradually weaker, until at last it was so reduced that protection to dogs was afforded by inoculation.

Our time will not permit me to proceed further. I have but glanced at the subject under notice, but I hope sufficient has been brought out to show that we are on the threshold of a vast inquiry. In pursuing it we shall make many mistakes, but the light will come, and even our mistakes will serve as beacons against future errors. All real progress is slow. It was not till 200 years after an English writer described the parasite of that loathsome disease, the itch, that the evidence was accepted; and yet this affection is external, and the parasite is large enough to be seen with the naked eye. Now and then the discovery of the parasite was reported, but few believed it, and down to our own time little or nothing was known of its nature. We find some of the older writers stating that the disease was caused by a chemical sort of phlegm, by a peculiar ferment in the blood, by a bilious humour of the body, by deranged secretions, and so on without end. I could find you books of recent date where the same rigmarole is still indulged in to account for typhoid and other fevers. At the close of last century Lorry denied that anyone had ever seen the parasite of scabies or its eggs, and contended that the parasitic theory could not be true—(1) Because some acute diseases had been cured as soon as the itch broke out; (2) because it was known that the itch was driven in to external organs; (3) because many serious diseases could be cured by the inoculation of itch. Change the name of the disease and I will find you modern parallels equally conclusive. As late as 1833 Cazenave wrote that as to the immediate cause of scabies "it is still entirely unknown. Some have attributed it to the presence of an insect, but we believe ourselves authorized to think that the acarus scabiei has no existence." Within a year of that time there was not a clinic in Europe where the acarus had not been exhibited. If then it required 200 years to complete an inquiry of this kind under the most favourable conditions, need we be discouraged if under conditions infinitely more difficult to control, we find our progress slow, or if now and again we have to retrace our steps through straying into wrong paths. Remember that we have a grand object before us, the stamping out of all infectious diseases. Some of us cannot hope to live long enough to see this consummation, but we are encouraged to believe that younger men will take up the work which older and, it may be, feebler hands have begun; and when I look round this Society, and on its younger offspring —the Field Naturalists' Section—and when I witness that we have amongst us gentlemen who already are showing interest in microscopical and biological research, am I anticipating too

Digitized by Google

much when I cherish the belief that when the chronicle shall be written of those who have helped on the work of investigation, there may be found therein the names of some South Australians who shall have been led to take their first steps by that spirit of inquiry which is the aim of this Society to create and foster.

Election of Officers.

The election of officers for the coming year was as follows:—President, Professor Lamb, M.A.; Vice-Presidents, H. C. Mais, M.I.C.E., and H. T. Whittell, M.D.; Hon. Treasurer, Walter Rutt, C.E.; Hon. Secretary, W. L. Cleland, M.B.; Council, Rev. W. Howchin, F.G.S., W. E. Pickels, F.R.M.S., R. L. Mestayer, C.E., D. B. Adamson, Charles Todd, C.M.G., and W. Haacke, Ph.D.

Digitized by Google

THE TREASURER IN ACCOUNT WITH THE ROYAL SOCIETY OF SOUTH AUSTRALIA.

Dr.	£	s.	d.	Cr.	£	s.	d.
To Balance brought forward	275	13	7	By Transactions	97	16	11
Subscriptions	97	12	6	Printing and Advertisements	20	16	3
Sale of Transactions	3	8	6	Natural History Section	50	0	0
Natural History Section	25	0	0	Assistant Secretary—Salary	21	0	0
Government Grant	130	18	6	Caretaker...	1	10	0
Interest on Deposit Receipt	12	0	0	Postage and Sundries	6	0	2
				Cupboard...	32	10	0
				Deposit Receipt	250	0	0
				Balance in Bank...	64	19	9
	£544	13	1		£544	13	1

Audited and found correct.

LIONEL C. E. GEE,
Auditor.

THOMAS D. SMEATON,
Treasurer.

6th October, 1884.

Digitized by Google

DONATIONS TO THE LIBRARY

For the Year 1883-4.

I.—Transactions, Journals, and Reports.

Presented by the respective Societies, Editors, and Governments.

Ballarat School of Mines—Annual Report, 1883.

Baltimore—American Chemical Journal. Vol. V., Nos. 4 and 5 and 6.

———— American Chemical Journal. Vol. VI., Nos. 1 to 8.

———— John Hopkins University Circulars. Vol III., Nos. 25 to 32.

Batavia—Natuarkundig Tijdschrift voor Nederlandsch-Indie. Vol. XLII. and XLIII.

Belfast—Proceedings of the Belfast Natural History and Philosophical Society for 1882-3.

Berlin—Sitzungberichte der Königlich-Preussichen Akademie der Wissenschaften zu Berlin. Nos. XXII. to LIII., and Index.

Bordeaux—Memoires de la Société des Sciences Physiques et Naturelles de Bordeaux. Second series; Tome IV.; Parts 1 and 2; 1880.

Boston—Memoirs of the Boston Society of Natural History. Vol. III., No. VI., 1883.

———— Proceedings of the Boston Society of Natural History. Vol. XXI., Part 4; Vol. XXII., Part 1; 1883.

———— Proceedings of the American Academy of Arts and Sciences. New Series. Vol. IX. Vol. X., 1882.

Buenos Aires—Boletin de la Academia Naçional de Ciencias en Cordoba (Republica Argentina). Tomo VI.; Entrega 1, 1884.

Cambridge, U.S.A.—Annual Report of the Curator of the Museum of Comparative Anatomy at Harvard University for 1882-83.

———————— Bulletin of the Museum of Comparative Anatomy at Harvard College; (Whole Series, Vol. VIII. Geological Series, Vol. I.) No. 9 on the Relations of the Trianic Traps and Sandstones of

Digitized by Google

the Eastern United States. No. 10 The Folded Heidelberg Limestones east of the Catskill.

Cambridge, U.S.A.—Bulletin of the Museum of Comparative Anatomy at Harvard College. Vol. XI., No. 1, Reports of the results of Dredging. Vol. XXI., Report on the Anthozoa, and on Some Additional Species dredged by the "Blake" and by the "Hawk." No. 2, a Chapter in the History of the Gulf Stream.
Nos. 3, 4, 5, 6, 7, 8, 9.
No. 10, Biblography.
No. 11, Acalephs.

Cassel—XXIX. and XXX. Bericht des Vereines für Naturkunder zu Cassel uber die Vereinesjahre vom 18 April, 1881, bis dahin, 1883.

Cincinnati—Scientific Proceedings of the Ohio Mechanics' Institute. Vol. I., No. 4, 1884.

Davenport—Proceedings of the Davenport Academy of Natural Sciences. Vol. III., parts 1, 2, 3.

Edinburgh—Royal Society of Edinburgh. List of Members, Fellows, Council, &c., 1884.

Göttingen—Nachrichten vom der K. Gesellschaft der Wissenschaften und der Georg-Augustus Universitat zu Göttingen. Aus dem Jahre, 1882.

Lausanne—Bulletin de la Société Vaudoise des Sciences Naturelles. Serie 2, vol. XIX., No. 89; vol. XX., No. 90.

Leicester—The Midland Medical Miscellany and Provincial Medical Journal. Vol. III., No. 28.

London—British Mail. January, 1884.

——— Medical Press. No. 2,357. July 2, 1884.

——— Transactions of the Entomological Society of London for 1883.

——— Proceedings of the Royal Colonial Institute. Vol. XIV.

——— Proceedings of the Royal Society. Nos. 220 to 226.

——— Journal of the Royal Microscopical Society. Series II., vol. III., parts 5 and 6; series II., vol. IV., parts 1, 2, 3, 4.

——— List of Fellows of the Royal Microscopical Society.

Montreal—Catalogue of Canadian Plants. Part I., Polypetalæ (Geological and Natural History Survey of Canada).

——— Report of Progress; 1881-82-83 (Geological and Nat. Hist. Survey of Canada); also maps.

Digitized by Google

Munich—Königlich-Bayerischen Akademie der Wissenschaften,
——— Sitzungberichte der Mathematisch-Physikalischen Classe; 1882-1883.
——— Abhandlungen der Mathematisch-Physikalischen Classe.
New Zealand—Eighteenth Annual Report on the Colonial Museum and Laboratory, together with the Fourteenth Annual Report on the Botanic Garden, New Zealand.
Nova Scotia—Transactions and Proceedings of the Nova Scotia Institute of National Science of Halifax, Nova Scotia; vol. VI., part 1.
New South Wales—Annual Report of the Department of Mines for New South Wales for 1883.
——————— List of Exchanges and Presentations made by the Royal Society of New South Wales, 1883.
——————— Journal and Proceedings of the Royal Society of New South Wales.
——————— Royal Society, New South Wales Anniversary address by the President, H. L. Russell, B.A., M.D., F.R.A.S.
——————— Proceedings of the Linnean Society of New South Wales; vol. VIII., part 3, 4; vol. IX., part 1, 2.
——————— Report of the Trustees of the Australian Museum of New South Wales for 1883.
——————— Report of the Free Library, Sydney, 1883-4.
Philadelphia—Proceedings of the Academy of Natural Sciences of Philadelphia. Part II., III, 1883; Part I., 1884.
Queensland—Proceedings of the Royal Society of Queensland. Vol. I.; part 1.
Rio de Janeiro—Archivos do Musen Nacional do Rio de Janeiro. Vol. IV., 1879; Vol. V., 1880.
Salem, U.S.—Bulletin of the Essex Institute, 1882. Nos. 1 to 12.
South Australia—Annual Report of the Governors of the South Australian Institute.
——————— Annual Report of the Government Geologist, with plans, 1882-3.
——————— Report on the Progress and Condition of the Botanic Garden, &c., for 1883.
——————— Meteorological Observations made at the Adelaide Observatory in 1881. By the Government Astronomer, Chas. Todd, C.M.G., F.R.A.S., &c.

Digitized by Google

Tasmania—Papers ordered to be Printed (by the Legislative Council, &c).
———— Statistics of the Colony of Tasmania, 1882.
———— Census of Tasmania, 1881.
———— Report of the Royal Society of Tasmania for 1883.
Victoria—Statistical Register of Victoria for 1882. Part I., Blue Book; Part II., Population; Part III., Law, Crime, &c.; IV., Vital; V., Finance; VI., Population; VII., Production; VIII., Interchange.
———— Statistical Register of Victoria for 1883. Part I., Agricultural Statistics; II., Population; III., Finance.
———— Transactions and Proceedings of the Royal Society of Victoria. Vol. XX., 1883-84.
———— Census of Victoria, 1881.
———— Census of Victoria for 1882. General Report.
———— Census of Victoria for 1881. Part VII., Occupations of the People.
Vienna—Kaiserlich Akademie der Wissenchaften in Wien. Sitzung der Mathematisch-Naturwissenschaftliche Classe. Nos. 5 to 27.
——— Verhandlungen der Kaiserlich-Königlichen Geologischen Reichenstalt. Nos. 10 to 18.
——— Mittheilungen des Ornithologischen Vereines in Wien, 1884. Nos. 1 to 7.
——— Bieblatt zu den Mittheilungen des Ornithologeschen Vereines in Wien. Nos. 2 and 3.
——— Verhandlungen der K. K. Zoologisch-botanischen Gesellschaft. Jahrgang, 1883.
Washington—Daily Bulletin, &c., September, October, November, and December, 1877. Signal Officers U.S. Army.
———— First Annual Report of the Bureau of Ethnology, 1879-80. By J. W. Powell.
———— U.S. Geological Survey of the Territories. Second Annual Report, 1880-81.
———— Monographs II. Tertiary History of the Grand Canon District. Maps and Panoramas to the Twelfth Annual Report.
———— Wyoming and Idaho; parts 1 and 2.
———— Report of the Smithsonian Institution for 1881.
Würzburgh — Sitzungberichte der Physical-Medicenisch-Gesellschaft zu Wurzburg. Jahr., 1883.

Digitized by Google

Books and Pamphlets.

(Names of donors in italics.)

Australian Museum Governors—Catalogue of a Collection of Fossils in the Australian Museum.

British Museum Trustees—Fossil Sponges, British Museum.

Gardiner, M.—Determination of the Motion of the Solar System in Space.

——— Solution of the Celebrated Fundamental Question of Dynamics.

Hayter, H. H.—Handbook of Victoria.

——— Victorian Year-Book, 1882-3.

Macleay, W.—Catalogue of Australian Fishes; vols. I., II., and supplement.

Hector, James—Handbook of New Zealand, 1883.

Lamb, H.—On Electrical Motions in a Spherical Conductor.

Liversedge, A.—On the Bingera Meteorite, New South Wales. Preliminary notice.

——— The Deniliquin or Barratta Meteorite.

——— On the Chemical Composition of Certain Rocks, New South Wales, &c.

——— Rocks from New Britain and New Ireland.

Mueller, Baron F.—Observations on New Vegetable Fossils of the Auriferous Deposits.

——— The Plants Indigenous to Shark Bay and Vicinity.

——— Eucalyptographia: A Descriptive Atlas of the Eucalypts of Australia and adjoining Islands. Ninth decade.

Natterer, J.—Brasilische Sangethiere Resultate, von Reisen in der Jahren 1817 bis 1835.

Netto, L.—Aperçu sur de la Theorié de l'Evolution.

Radlkofer, L.—Ueber die Methoden in der Botanischen Systematik insbesondere die anatomische Methode.

Russell, H. C.—The Spectrum and Appearance of the Recent Comet.

——— Physical Geography and Climate of New South Wales.

——— The Sydney Observatory: History and Progress.

——— Results of Rain and River Observations for 1882.

——— Anniversary Address to Royal Society of New South Wales.

Digitized by Google

Schomburgk, R.—Description of Part of Femur of Nototherium Mitchelli. From Quarterly Journal of the Geological Society, August, 1882.

Stirling, Jas.—On the Caves Perforating Marble Deposits, Limestone Creek.

Tenison-Woods, J. E.—The Coal Resources of Queensland.

Thomas, J. D.—Hydatid Disease, with Special Reference to its Prevalence in South Australia.

Wyatt, W.—Monograph of certain Crustacean Entomostraca.

——— Some account of the Manners and Superstitions of the Adelaide and Encounter Bay Aborigines.

Salem—Pocket Guide to Salem, Mass.

——— Plummer Hall: its Libraries, its Collections, and Historical Associations.

——— North Shore of Massachusetts Bay: A Guide, 1882.

Digitized by Google

LIST OF FELLOWS, MEMBERS, &c.,

NOVEMBER 3, 1884.

Those marked (F) were present at the first meeting when the Society was founded. Those marked (L) are Life Fellows. Those marked with an asterisk have contributed papers.

		Date of Election.
HONORARY FELLOWS.		
Angas, Geo. French, F.L.S., C.M.Z.S.	London	1879
Barkley, Sir Henry, K.C.M.G., K.C.B.	.. .. ..	1857
Ellery, R. L. J., F.R.S.	Melbourne	1876
*Garran, A., LL.D.	Sydney	1853
*Hull, H. M.	Hobart	1855
Jervois, H. E. Sir W. F. D., K.C.M.G., C.B.	New Zealand	1878
Little, E.	.. .. ..	1855
Macleay, W., F.L.S.	Sydney	1878
*Mueller, Baron F. von, K.C.M.G., F.R.S.	Melbourne	1879
Russell, H. C., B.A., F.R.A.S. ..	Sydney	1876
Warburton, Col. P. E., C.M.G. ..	Beaumont	1858
*Woods, Rev. J. E. T., F.L.S., F.G.S.	Sydney	1877
CORRESPONDING MEMBERS.		
Bailey, F. M., F.L.S.	Brisbane..	1881
Canham, J.	Stuart's Creek	1880
Chandler, T.	Peake	1881
*Cloud, T. C., F.C.S.	Wallaroo	1881
*East, J. J.	Mallala	1884
*Foelsche Paul	Palmerston	1882
Goldstein, J. R. Y.	Melbourne	1880
*Hayter, H. H., M.A., C.M.G., F.S.S.	Melbourne	1878
Holtze, Maurice	Palmerston	1882
*Kempe, Rev. J.	Finke, McDonnell Ranges ..	1880
*Richards, Mrs. A.	Fowler's Bay	1880
*Scoular, Gavin	Smithfield	1878
*Stirling, James, F.L.S.	Omeo, Victoria	1883
*Tepper, J. G. O., F.L.S.	Adelaide	1878
FELLOWS.		
*Adamson, D. B.	Angas-street	1867
Abbott, A. G.	Kingston	1884
Angas, J. H.	Angaston	1874
Biggs, Col.	Edwardstown	1878
Beresford, D. J. D.	Adelaide	1884
Black, A. B.	.. .. ..	1882
Bœttger, Otto	Flinders-street	1884
Brown, J. E., F.L.S.	Conservator of Forests, Adel.	1882
Brown, L. G.	Two Wells	1882
Browne, H. Y. L.	Gov. Geologist, Adelaide ..	1883

Digitized by Google

Bruer, J.	King William-street ..	..	1883
Brunskill, Geo.	Morgan	..	1878
Burchell, F. N.	Adelaide	..	1881
Bussell, J. W.	Adelaide	..	1884
Campbell, Hon. A., M.L.C., L.R.C.P. Edin...	Adelaide	..	1882
Caterer, T. A., B.A.	Norwood	..	1882
*Chalwin, Thos., M.R.C.V.S. ..	Adelaide	..	1877
Chapple, F., B.A., B.Sc.	Prince Alfred College ..	..	1876
Chapman, W. E.	.. .. ..	..	1883
Cleland, W. L., M.B., Ch.M., F.R.M.S.	Parkside	..	1879
*(L)Cooke, E.	Adelaide	..	1876
Cox, W. C.	Semaphore	..	1880
Cornish, W. H.	Adelaide	..	1883
Crawford, F. S.	Adelaide	..	1865
*Davenport, Sir Samuel	Adelaide	..	1856
Davies, Edward	Hutt-street	..	1882
Davis, F. W.	*Advertiser* Office ..	..	1882
Dobbie, A. W.	Gawler-place	..	1876
Driffield, F. S. C.	Adelaide	..	1883
Elder, Sir Thomas	Adelaide	..	1871
Evans, Thomas	Adelaide	..	1883
Farrar, G. E.	Adelaide	..	1882
*Fletcher, Rev. W. R., M.A. ..	Kent Town	..	1876
Foote, H.	Outalpa	..	1883
Fowler, W.	Kulpara	..	1882
Gall, D...	North Adelaide	..	1865
Gardner, Wm., M.D., Ch.M. ..	.. .. ..	..	1883
Gee, Lionel C.E.	Adelaide	..	1882
Giles, George F...	Adelaide	..	1883
Gill, Geo.	Grenfell-street	..	1884
Gill, H. P.	Public Library, &c. ..	..	1883
Gosse, Charles, M.D.	Adelaide	..	1877
Gosse, John, M.R.C.S., Eng. ..	Wallaroo	..	1884
*Goyder, Geo., jun.	Adelaide	..	1880
Grundy, E. B.	Adelaide	..	1882
*Haacke, Wm., Ph.D.	Adelaide	..	1882
*Harris, C. H.	Adelaide	..	1883
Harrold, A. L.	Pirie-street	..	1876
Harry, Thomas	Adelaide	..	1878
*Haslam, John, C.E.	Adelaide	..	1883
Hay, Hon. A., M.L.C.	Linden	..	1861
Henry, A., M.D.	Adelaide	..	1882
Hill, W.	Mitcham	..	1884
Hopkins, Rev. W.	Glenelg	..	1880
*Howchin, W., F.G.S.	Goodwood East	..	1883
Hughes, H. W.	Booyoolie	..	1883
*Hullett, J. W. H.	Port Augusta	..	1876
Johnson, J. A.	Adelaide	..	1875
*Joyce, J. F., M.R.C.S., Eng. ..	Adelaide	..	1880
(r) Kay, R.	Public Library, &c. ..	..	1853
Kelly, Rev. Robert	Port Adelaide	..	1884
Knevett, S.	Adelaide	..	1878
Lamb, Prof., M.A., F.R.S. ..	Adelaide University ..	..	1883
Laughton, E.	Adelaide	..	1874
Leary, J. W.	South-terrace	..	1883
Landon, A. A., M.D.	Adelaide	..	1884
Lloyd, J. S.	North Adelaide	..	1856

Digitized by Google

Magarey, A. T.	North Adelaide	1873
*Magarey, S. J., M.B. ..	Adelaide	1874
Mais, H. C., M.I.C.E. ..	Adelaide	1883
*Mayo, Geo., F.R.C.S., Eng.	.. .. ..	1853
Mayo, G. G.	Adelaide	1874
Mestayer, R. L., C.E. ..	Adelaide	1883
*Meyrick, E., B.A. ..	Christchurch, New Zealand	1881
Middleton, W. J. E. ..	Kangarilla	1882
Mohan, J. H.	Crafers	1883
Molineux, A.	Kent Town	1880
(L)Murray, David	North Adelaide	1859
Munton, H. St.	Adelaide	1884
Nesbitt, W. Peel, M.B. ..	North Adelaide	1880
Neale, W. L.	Model School, Grote-street ..	1884
Nickolls, J.	Auckland, N.Z.	1883
O'Leary, P., M.R.C.S. ..	Port Victor	1884
Parker, Thos., C.E. ..	Port Adelaide	1883
Phillips, W. H.	Adelaide	1883
Pickels, W. E., F.R.M.S. ..	Adelaide	1883
Poulton, B., M.D. ..	Adelaide	1883
Rees, Roland, M.P. ..	Adelaide	1874
Rigaud, R. J.	*Register* Office	1882
Robertson, R., F.F.P.S. ..	Adelaide	1882
Rogers, Rev. N.	Moouta	1882
Russell, W.	Port Adelaide	1879
*Butt, Walter, C.E. ..	Adelaide	1876
Salom, Hon. M.	Adelaide	1866
*Schomburgk, R., Ph.D. ..	Adelaide	1865
*Smeaton, Stirling, B.A. ..	Adelaide	1882
*Smeaton, Thos. D. ..	Adelaide	1857
Smith, E. Mitchell ..	Adelaide	1883
Smith, R. Barr	Adelaide	1871
Smith, William	Hydraulic Engineer's Office	1880
Smyth, C. B.	Hydraulic Engineer's Office	1884
Smyth, J. Y., B.A., B.E. ..	Norwood	1882
Sparks, H. Y.	Glenelg	1878
Spiller, E.	Government Printing Office	1884
*Stirling, E. C., M.D. ..	North Adelaide	1881
Stuckey, J. J., M.A. ..	Adelaide	1878
*Tate, Prof. R., F.G S. ..	North Adelaide	1876
*Thomas, J. D., M.D. ..	Adelaide	1877
Thow, Wm.	Woodville	1878
*Tietkins, W. H., F.R.G.S.	Millswood	1881
Thomson, R.	*Register* Office	1883
*Todd, Charles, C.M.G., &c.	Adelaide	1856
Tomkinson, S.	Adelaide	1876
Tyas, J. W.	Adelaide University ..	1882
Umbehaun, C.	General Post Office ..	1879
*Varley, A. K.	Mount Gambier	1883
*Verco, J. C., M.D. ..	North Adelaide	1878
Vickery, G.	Meadows	1868
Ware, W. L.	Adelaide	1878
Waiuwright, E. H., B.Sc. ..	St. Peter's College ..	1883
Watson, Rev. John ..	Parkside	1884
Way, E. W., M.B. ..	Adelaide	1879
Way, S. J., Chief Justice ..	Adelaide	1859
Wheeler, F.	Adelaide	1884

Digitized by Google

White, R. A.	Adelaide	1882
Whiting, J. B.	Destitute Board Office ..	1882
*Whittell, H., M.D.	Glenelg	1882
Woodward, H. O.	Gov. Geologist's Office ..	1883
*Wragge, C. L., F.R.G.S.	Torrens' Observatory ..	1877
Wyatt, Wm., M.R.C.S.	Burnside	1859
Young, Wm., M.A.	Hindmarsh	1880

ASSOCIATES.

Burchell, D.	Surveyor-General's Office ..	1883
Hodgson, Mrs.	Port Victor	1884

Digitized by Google

APPENDIX.

TRANSACTIONS

OF THE

Field Naturalists' Section of the Royal Society

OF SOUTH AUSTRALIA.

This Section was established by a resolution of the Royal Society of South Australia on September 4th, 1883, and the rules adopted at the following meeting held on October 2nd, as recorded in Vol. VI. of the Transactions. In the first week of November Prof. Tate delivered a preliminary lecture in the Town Hall, under the auspices of the Royal Society, on the objects of this Section, Dr. H. T. Whittell presiding. The Chairman said that the establishment of the Section was owing to the desire of the Royal Society to meet the wishes of a number of studiously disposed persons who wished to undertake the study of Natural History from a more elementary point than that pursued by the Royal Society. Prof. Tate, in the course of a very interesting lecture, stated that it was not intended to exclude those who solely sought pleasant companionship and agreeable change, and that ladies as well as gentlemen would be welcomed. The lectures should deal with subjects alike entertaining and instructive, and that one of the chief features should be the microscope. Mr. W. H. Selway, jun., proposed a vote of thanks to the Professor, which was carried with acclamation, when the proceedings terminated with a similar vote to the Chairman.

RULES.

1. The general management of this Section shall be controlled by a Chairman, two Vice-Chairmen, a Secretary, and a Committee of eight, five to form a quorum.

2. The Chairman, Vice-Chairmen, and Committee shall be elected at the annual meeting in October.

Digitized by Google

3. The Chairman shall not be eligible for office for more than two consecutive years, and one of the Vice-Chairmen shall retire each year.

4. Candidates for admission, not being members of the Royal Society, must be proposed and seconded by two members of the Section at one meeting, and be balloted for at the next ensuing meeting; one black ball in five to exclude.

5. Evening meetings shall be held on Tuesdays, at the discretion of the Committee of Management, for the purpose of reading papers, dealing with the natural history of Australia (more particularly of the neighbourhood of Adelaide), or for the purpose of mutual instruction.

6. There shall be at least eight Field Meetings during the year; the time and place to be arranged by the Committee.

7. At the annual general meeting a statement of accounts shall be submitted by the Secretary and duly certified by two auditors appointed at the previous ordinary meeting, preparatory to being handed to the Treasurer of the Royal Society.

8. The Section may from time to time elect as honorary members those who have been proposed and seconded in the usual way, and have been unanimously elected by ballot. This shall also apply to corresponding members.

9. Any member owing the subscription to the Section and neglecting to pay the same on or before the first day of January, shall be liable to have his name removed from the list of members of the Section; provided always that written application for the same shall first have been made by or on behalf of the Treasurer of the Royal Society; and, provided also, that the Committee shall have power to restore the defaulter's name at his request, after payment of arrears.

10. The rules and regulations of the Section shall not be altered unless a written notice of motion, signed by not less than five members, be given at a meeting of the Section; and thereupon such motion may be brought forward at the next meeting.

11. Any resolution passed under rule 10, altering or repealing the rules of the Section, shall be in force until the meeting held in the month of October following; and if not then confirmed, shall thereafter be held void and of no effect.

12. On the written requisition of twenty members, delivered to the Secretary, an extraordinary general meeting may be called to consider and decide upon the subject mentioned in the requisition.

13. The Committee shall be empowered to frame rules for the conduct of excursions arranged for by them.

Digitized by Google

RULES FOR THE CONDUCT OF FIELD EXCURSIONS

1. Each member shall have the privilege of introducing two friends; such privilege not to extend to any person who shall have been a visitor at two successive meetings.
2. A Chairman to be elected as at ordinary meetings.
3. The Secretary to act as conductor, or in his absence, some member of the Committee nominated by him.
4. No change to be made in the programme, or extra expense incurred, except by the consent of two-thirds of the members present.
5. No fees, gratuities, or other expenses to be paid except through the conductor.
6. Every member or visitor to have the accommodation assigned by the conductor. Where accommodation is limited, consideration will be given to priority of application.
7. Accommodation cannot be supplied unless tickets are obtained before the time mentioned in the special circular.
8. Those who attend an excursion without previous notice will be liable to extra charge, if extra cost be thereby incurred.
9. No intoxicating liquors shall be provided at the expense of the Section.

EXCURSIONS.

First Excursion—Saturday, November 24, 1883.

Just before 2 o'clock p.m., about 60 members met at the Railway Station, North-terrace, and proceeded in a reserved carriage to Belair, where the party was met by Mr. Cooke, the keeper of the Government Farm, under whose guidance the party was placed. After passing a short distance along the line, a halt was called, and Prof. Tate explained that they were in the centre of a curiously formed basin. The sides of the railway cutting indicated that the soil was decomposing talcose slate, and that in the next cutting they would find the debris of this talcose slate, viz., angular gravel and sandy beds with underlying clays. The vegetation was entirely different from that of the surrounding area, being similar in character to heathy scrub lands. Judging from the lithological evidence, he considered these superficial beds, which were generally gold-bearing, to be of fluviatile or lacustrine origin, and co-eval with the Upland Miocenes of the Gawler district. The elevation at which they stood was just on the verge of the upper limits of the Peppermint Gum (Eucalyptus odorata) and the lower limits of the White Gum (E. leucoxylon). The characteristic flora of the heathy ground were indicated by the Grass Tree (Xanthor-

Digitized by Google

rhœa semiplana), the Scrub Sheaoak (Casuarina distyla), Hakeas, and other proteaceous plants, and the fact that Leptospermums and other myrtaceous plants grew here was always an assurance that the ground was amply supplied with water. The season was too late for most orchids. The professor pointed out a very rare one, Diuris sulphurea, which until last year was not known westward of the South-Eastern District. Mr. Tepper secured a specimen of Pterostylis rufa, a sensitive orchid, otherwise only occurring in the mallee regions. Professor Tate also drew attention to the most curious and interesting Pterostylis barbata, which he roughly described as a flower resembling a hood-like trap with a shutter. Should any small insect alight on this shutter, or irritable labellum, it flew up and imprisoned the insect without hurting it. For a period of some twenty minutes it would be encased, and by its efforts to escape would cover itself all over with the pollen. At the expiration of the period mentioned, the tension would be relaxed, and the fly escape, only to be caught by some other orchid, where the pollen it had brought would be utilised to secure cross fertilization. The higher slopes and the waterfall were visited, which latter is formed by an escarpment of quartzose sandstone. The following plants were found, viz.: —Native indigo (Indigofera australis), Verbena officinalis, Cynoglossum australis and suaveolens, Meionectes Brownii, and the rare Cyperus tenellus, only added to our flora in 1882. Rich fern banks were met with, and six species collected.

At half-past 5 the party assembled at the Railway Station, and returned in a reserved carriage to town.

Second Excursion—December 8, 1883.

Between 60 and 70 members proceeded to Crafers by the 2 p.m. train in a reserved carriage. On arrival the party proceeded under the leadership of the Hon. Secretary, Mr. Pickels, to the neighbourhood of Mount Lofty, when, after walking about a mile, Prof. Tate called attention to the fact that they were now in the region of the stringybark forest, and indicated the soft coarse-grained sandstone that appeared on the surface of the stringybark country, and that so far as the Mount Lofty Ranges were concerned, both were co-terminous. Of the stringybarks, two species existed here, viz., Eucalyptus obliqua and E. capitellata. The sandstones rested unconformably upon the slaty rocks. Both had a dip to the south-east, but that of the former was much the less inclined of the two, and in consequence water was encountered all along the eastern slope of the range in the form of springs issuing from the junction of the two sets of beds. At the heads of gullies,

Digitized by Google

especially on the eastern flanks, ferns, lycopodiums, and other plants characteristic of humid stations abounded. With respect to the geological age of these formations little had as yet been forthcoming to replace conjecture with certainty. It was often thought by the inexperienced that the underlying slate rocks contained plant remains, and these were appealed to as affording conclusive proofs that the series contained coal. These plant-like markings are produced by the infiltration of oxide of manganese, and are not of organic origin.

Though the stringybark country was not rich either in animal or vegetable life, yet in the course of the day many characteristic species of this tract were found—notably Aster Sonderi, with its large oak-like leaves and glorious white flowers supported on stalks a foot in length, the only known locality for this plant being the stringybark forests of the Mount Lofty Ranges; the graceful Marianthus bignoniaceus, with pendulous, yellow and orange flowers; and the Stylidium (Candollea) graminifolium. The last-named, being a sensitive plant, amused and interested many of the party on testing its irritability. The style, crowned by two anthers, hangs down through a notch in the corolla. When touched by an insect, or anything else, it assumes an horizontal position with great rapidity, and then rests upon the corolla. The object to be gained by this action was stated to have remained a mystery, in spite of the earnest attention which scientific men have given to the matter, and that its discovery would be hailed with satisfaction by botanical students.

An *al fresco* business meeting was then held, Professor Tate presiding, when eighteen new members were elected unanimously, after which the meeting terminated, and the party returned to Crafers.

Third Excursion—New Year's Day.

About 90 ladies and gentlemen proceeded by three coaches to Hallet's Cove for a whole-day excursion, noting by the way the thinly bedded slaty rocks and limestones interstratified by thick quartzites which compose the ascent to Tapley's Hill, and the highly crystalline arenaceous marbles occupying the higher levels. Drawing up at a house on Mr. Rymill's estate the party walked down to the valley of Field's River, a small rivulet with high and steep banks, except near the mouth where it enters the sea at Hallett's Cove, named after Capt. Hallett, who had an interest in the now deserted Worthing Mine, about a mile inland from the shore.

After lunch Professor Tate led the way to the shore. The river empties itself into the sea between two bold headlands

Digitized by Google

about a mile apart, the beach being strewn with stones from the size of a pebble up to large boulders. The presence of granite was noted among these shore pebbles, having been probably transported from a distance by some natural agency, as granite does not occur *in situ* in the neighbourhood. The larger boulders were seen to be massive conglomerates containing pebbles of gneiss and quartzites. Professor Tate explained that this conglomerate was to be seen *in situ* some distance northward, and that it formed part of a series that occupied a much lower position in the sedimentary rocks of the colony. The southern headland, appropriately called Black Point, is formed of dark shales of a purple color standing nearly on edge. By approaching this point from the rear, the crest was reached, and, by looking down, it was seen that the stratification is interrupted by curves and intricate foldings.

Proceeding along the top by a narrow terrace, hemmed in above by the second cliff of horizontally stratified grey sandstone, the party arrived at a place scarcely a quarter of a mile distant from Black Point, where the surface of the underlying slate was laid bare, quite smooth, and scratched and grooved in a generally north and south direction. These polished and scratched features Prof. Tate explained as due to the action of ice at some former period, whereupon a lively discussion took place, those members well versed in recognising the toolmarks made by ice acquiescing with the opinion of the Professor. On returning, the party proceeded to examine the second line of cliffs, composed of red and grey Tertiary sandstone, and found that the sandstone, at about half the height of the cliffs, contained a number of fossil shells. Prof. Tate said that he had found between 50 and 60 species of fossils in this formation, which could be seen to better advantage at Aldinga, where corresponding beds rest on older fossiliferous rocks. This upper series he referred to the Miocene period, and the lower, at Aldinga, to the Eocene. It was the nearest place to Adelaide where the formation could be studied. The surface was of an arid character, but in spring yielded many interesting plants. Of these the following were more particularly observed, viz.:—Goodenia amplexans, G. albiflora, Myoporum parvifolium, Pittosporum phylliræoides, Ptilotus nobilis, Sida corrugata, Boerhævia diffusa.

On re-assembling at the encampment by the stream a meeting was held, Prof. Tate presiding, when several members were elected. After tea had been partaken of and an early return party taken their leave, the remaining members were conducted up the gorge, where Professor Tate pointed out the rocky walls of massive limestones, here and there crumpled and bent in a most intricate

Digitized by Google

manner. Attention was also directed to a plant growing among the rocks, and gathered by Mr. Tepper, viz., Euphorbia eremophila, which the Professor said was well known to the sheepfarmer of the Far North on account of its poisonous qualities, but has rarely, if ever before, been seen in the southern parts of the colony.

At about 6 p.m. the coaches started on their homeward journey, and the city was reached at an early hour.

Fourth Excursion—February 2, 1884.

About 90 ladies and gentlemen proceeded in reserved carriages to Aldgate, from whence a special engine took them on to Bridgewater. Here they were met by Mr. E. Guest, of Balhannah, who had consented to undertake the guidance of the party through the grounds of Messrs. Dunn & Co., who had kindly granted permission. Following the mill-race the direction towards Mount George was taken. Around the sheet of water known as Dunn's dam, the following introduced plants were noticed, viz., the ribwort (Plantago lanceolata), Dutch clover (Trifolium repens), chamomile (Matricaria camomilla), sheep's sorrel (Rumex acetosella), dock (R. obtusifolius), and the yarrow (Achillea millefolium). An unsuccessful search was made for a lamprey inhabiting Cox's Creek, and believed to be a species at present unknown to the scientific world. The following native plants were pointed out by Prof. Tate as rare, viz., Siegesbeckia orientalis, Gratiola Peruviana, Prunella vulgaris, Polygonum minus, Juncus prismatocarpus, Scirpus inundatus, and one of the native fuchsias, viz., Correa decumbens, the latter said to occur nowhere else than in the valley of the Onkaparinga River.

An open-air meeting being called, presided over by Prof. Tate, ten new members were elected; and a few unimportant business details being disposed of, the party proceeded towards Mount George. On arriving at the summit, Prof. Tate stated that the upper part of Mount George was a grand rocky bluff of quartzose grits, as were also those of all the peaks in the Mount Lofty Range, whilst the slopes were composed of talcose slates. The contour was obviously due to the difference of the structure and composition of the two sets of beds. This bluff, like all the high ground around, was covered with stringybark forest, seemingly of one species, viz., Eucalyptus capitellata, corroborating the observations of Mr. J. E. Brown, F.L.S., in the "Forest Flora," that "trees of this species are more numerous in the inland stringybark forests than those of its compeer, E. obliqua." Few shrubs and plants were in flower, except Bursaria spinosa, a myrtaceous shrub; and Ixodia

Digitized by Google

achilleoides, an everlasting composite. Here was also seen in great abundance a leafless orchid, Dipodium punctatum, about two feet in height, bearing numerous purplish flowers with darker spots. A few plants of Tetratheca were still found in bloom, and special attention was directed to a white double variety gathered. A few specimens of the rather rare leguminous shrub, Viminaria denudata, were found, Prof. Tate stating that its specific name alluded to its want of leaves, whose functions were performed by its long, green, filiform leafstalks, several of which were found with a small oval leaf still attached to their ends. After accomplishing the steep descent from Mount George, the members left Bridgewater by the 6.16 p.m. train, and arrived in town at half-past seven.

FIFTH EXCURSION—SATURDAY, MARCH 1, 1884.

Eighty ladies and gentlemen proceeded in reserved carriages by the 2 p.m. train to Aldgate, and were then, by the courtesy of Mr. A. G. Pendleton, the Traffic Manager, sent on to Ambleside by a special engine. Here they were met by Mr. Guest, of Balhannah, who had consented to take the lead. Following the Onkaparinga, a large red-gum tree was pointed out by Mr. Guest as one of the largest, if not the largest gum tree in the district. It was estimated to be 150 feet high, and the stem 25 feet in girth. In one of the main forks of the branches, high above the ground, a tuft of the common Bracken (Pteris aquilina) was seen growing. Under this giant of the forest a meeting was held, Prof. Tate, F.G.S., &c, presiding. Eight new members were elected. Mr. Guest exhibited the following ferns collected on his way there, viz., Gleichenia circinata, Grammitis rutæfolia, and G. leptophylla.

Proceeding along the river, Prof. Tate called attention to the fact that it was margined by thickets of the Teatree (Leptospermum lanigerum), Silver Wattle (Acacia retinodes), and the native Raspberry (Rubus parvifolius). On and near the banks were the native Daisy (Brachycome graminea), Cyperus lucidus, Goodenia ovata, Hydrocotyle vulgaris, H. asiatica, Cladium glomeratum, the Maiden Hair fern (Adiantum æthiopicum), and Potentilla anserina, hitherto not known in South Australia except in the South-East.

The Onkapringa was fairly rich in aquatic species, among which the following were collected:—Heliocharis sphacelata, Potamogeton natans, Trigloetim procera, Myriophyllum variæfolium, and Ranunculus rivularis, to which some others succeeded in adding Polyganum prostratum, Ottelia ovalifolia, and Potamageton crispus as rare plants about Adelaide. A few fresh water molluscs were obtained, viz., the river mussel

Digitized by Google

(Unio ambiguus) and a small water snail (Bulinus bullatus). The forest trees consisted chiefly of the Red Gum, Eucalyptus rostratus, E. goniocalyx, and E. capitellata. In open grassy spots were seen Calocephalus lacteus, Eryngium vesiculosum, and Lagenophora emphysopus.

The members started for town at 6 p.m., and arrived about half-past 7.

SIXTH EXCURSION—SATURDAY, MARCH 22, 1884.

The party, consisting of 35 members, including two ladies, proceeded in a reserved carriage to Alberton by the 1.50 p.m. train. On arrival Mr. Councillor Kestel met the party, and conducted them to a gravel pit near the Station sunk through two feet of loam and fourteen feet of gravel. Mr. Kestel exhibited a piece of miocene limestone containing Turritella Aldingæ; pieces of jasper, quartz crystals, and titaniferous ironsand as found in it; also some valves of the Victoria cockle or Arca trapezia. Prof. Tate said he had no hesitation in regarding the gravel as of fresh-water origin, and of the same character as that intercalated with the red loams forming the drift or pliocene deposits of the Adelaide Plain. The shells of the Arca trapezia had doubtless been found at or near the surface, and he would hazard the theory that they had been left by the aboriginals at some time, who had cooked and eaten the mollusc at their camp, as evidenced by the number of pellets of burnt clay found with the shells. Exhibiting a geological map, he showed that they were standing on the margin of a marine formation about fourteen feet above sea level, and embracing the Dry Creek marshes. It was rich in fossils, all of which, as far as known, belonging to living species. The Arca was one of the most characteristic of these, but no longer a denizen of our waters.

A business meeting was then held, at which Prof. Tate presided, when the following gentlemen were elected as honorary members, viz.:—Messrs. H. Watt and D. Best, Vice-President and Hon. Secretary of the Victorian Field Naturalists' Club respectively, and three new ordinary members. A vote of thanks was offered to Mr. Councillor Kestel for his kindness in calling attention to the gravel pit.

Prof. Tate having indicated that the route they would follow was restricted to the marine deposit just referred to and its littoral sandhills, the party proceeded through Rosewater to the North Arm, noting the characteristic vegetation by the way. Amongst these were Salicornia australis, S. arbuscula, Kochia oppositifolia, Atriplex paludosum, Frankenia lævis, Suæda maritima, Mesembrianthemum australis, and Polycne-

Digitized by Google

mon (Hemichroa) pentandrum. Approaching the level of ordinary tides, thickets of Avicennia officinalis were met with, now in full bloom. Prof. Tate explained that the seeds mature in November, and germinating before shedding, the young plants were wafted by the wind to the mud flats, where they rooted at once. A large number of these, with their remarkably large embryonic leaves, were gathered by the party.

Among the samphire shrubs near high water mark some novelties peculiar to this station were obtained, viz., the pulmoniferous snails, Alexia meridionalis, Brazier, Plecotrema ciliata, *Tate*, and Ampullarina Quoyana; also, an undescribed Assiminea and a Modiola, the latter anchored in the mud by its byssal threads or beard.

Returning from the powder-magazine the party followed the railway loopline to Dry Creek. Along the line and intersecting the sandhills, at a low elevation, fragments of shells and sea pebbles were observed, and the Professor stated that about a quarter of a mile from the Dry Creek Station the margin of the elevated sea-bed was traceable as a white earthy limestone highly charged with Ampullarina Quoyana, Blandfordia striatula, Truncatellæ, and other estuarine species of mollusca.

The ground here being comparatively dry the difference of vegetation was most marked. The Salsolaceæ were most conspicuous, such as Kochia brevifolia, K. sedifolia, K. aphylla, Bassia diacantha, Atriplex semibaccatum, Chenopodium carinatum, Salsola Kali, and Angianthus tomentosus, the latter being very rare here. A quantity of the fruits of Nitraria Schoberi, the Native Grape bush, was gathered, and Euphorbia Drummondi, a spurge, specially pointed out by Professor Tate on account of its poisonous qualities.

Reaching Dry Creek the party returned in a reserved carriage by the 6.52 train to town.

SEVENTH EXCURSION—EASTER MONDAY, APRIL 14, 1884.

At half-past eight a.m. 60 ladies and gentlemen started in two coaches for Noarlunga jetty, which was reached near noon. After luncheon a meeting was held, when one member was elected, and then a start made for Whitton Bluff. On the road along the beach a dead specimen of the cuttle fish was found, considered as undescribed by Prof. Tate, who had attached the MS. name — "Sepia brevimana" — to it on account of its short tentacles. The tide prevented a near approach to the Bluff, which is very picturesque, and presents a grand and complete section of the older Tertiary rocks. The beds of the detached islet, known as the Gull Rock, were stated by the Professor to have the same dip as at the Bluff, and it was not

Digitized by Google

therefore a part fallen from the latter. Fossils abounded in the cream-coloured chalky rock, but mostly ill-preserved. Among them the fragments of the stem of a Pentacrinus, or Stone Lily, were abundant. The upper part of the cliff was formed of mottled sands, which by the weather are worn into fantastic shapes. Moving on to the mouth of the Onkaparinga, great numbers of small Crustacea were noticed in the pools, and numerous fossils were obtained from a very fine exposure of polyzoan limestone in the cliff near the mouth of the river. Two cannons were also noticed that had been left by the "Rapid" in the early years of the colony, their rusty condition showing the neglect with which these historical relics were treated. A rare salsolaceous plant—Threskeldia diffusa—was found here, almost its only station. Prof. Tate mentioned that in his drive from Aldinga he had met the purple amaryllid, Calostemma purpurea, and also Atriplex semibaccatum—the latter on the dry hillslopes of Pedlar's Creek, a very long way from its usual habitat. Conchologists were rewarded by finding various shells, almost peculiar to this station, among them being Marcia faba.

At half-past four the members assembled at the rendezvous, had tea at the Reynella Hotel, and arrived in town at a quarter past eight.

Eighth Excursion—Saturday, May 3, 1884.

A large number of ladies and gentlemen proceeded to Glenelg in a reserved carriage at 1.45 p.m. After crossing the bridge over the Patawolonga Creek at St. Leonards, a short business meeting was held, Prof. Tate presiding, at which eight new members were elected. The party then walked along the banks of the Patawalonga and the sandhills skirting it towards Henley Beach. Attention was directed by Prof. Tate, F.G.S., to the shell-beds and their contents, indicating several changes of level since they had lived at the localities where now seen. Near highwater-mark was found the remarkable pulmoniferous snail, Ampullarina Quoyana; and higher up in less brackish water, Bythinella Victoriæ, globose in shape, and not much larger than a pin's head; and Tatea rufilabris, pyramidal, and about a quarter-inch long. Many objects interesting to the microscopist were also taken. Among the plants in the sandhills, Melaleuca parvifolia and M. pustulata were noticed, and the rush lily (Xerotes leucocephala) was found in full flower, the attention of the members being directed to the difference in the male and female flowers. Reaching the rich flat of the Reedbeds, the party was disappointed as to the expected richness of this locality, drainage having converted it into a

Digitized by Google

desert for the naturalist. A few plants of some interest were found in flower, viz., Mimulus repens, Heliotropium Curassavicum, L. (the latter previously unknown in the Adelaide district), and Polygonum minus. Of introduced weeds, Solanum nigrum and the Bathurst burr (Xanthium spinosum), were specially noticed.

On arrival at Henley Beach the special tramcar ordered did not make its appearance, owing, as subsequently ascertained, to the carelessness of the manager of the Tram Company; and the party had to crowd into an ordinary car, reaching town about a quarter-past seven.

SPECIAL EXCURSION—SATURDAY, MAY 17, 1884.

About 50 ladies and gentlemen proceeded by special tramcar to Unley at 2.30 p.m. in order to visit the apiary of Mr. Robertson, at his residence, Unley Wurlie. On arrival, the company were met by Mr. Robertson, who most courteously conducted them to his collection of hives, showing them both the common dark bee and also the Ligurian, and explained the structure of the hives as well as the interesting economical points connected with the bees and their keeping. When the examination was completed, a vote of thanks was tendered to Mr. Robertson for his kindness.

NINTH EXCURSION—SATURDAY, AUGUST 2, 1884.

Between 50 and 60 ladies and gentlemen assembled at the Holdfast Bay platform about 2 p.m., and proceeded to Glenelg in a special carriage. On arrival at the beach a business meeting was held, presided over by Mr. W. Howchin, F.G.S., when two new members were elected. The Chairman stated that in the absence of Prof. Tate they were favoured with the presence of Mr. W. T. Bednall, who had kindly consented to give the party the benefit of his extensive knowledge respecting Australian conchology.

After some time the members were again called together, when Mr. Bednall named the specimens obtained, mentioning interesting facts connected with their life history. The following were the more noticeable:—Murex triformis, Trigonia margaritacea, a shell never taken alive in South Australian waters as far as known, though not uncommon in Tasmania, Mactra polita, Soletellina biradiata, Phasianella australis (the Pheasant Shell), and species of Pecten, Chama, Trochus, Haliotis, Fusus, Nassa, Purpura, Natica, Conus, Cypræa, Bittium, Turritella Siliquaria, Anatina, Venus, Lucina, Mytilus, and Spondylus. Along the Patawalonga empty shells only of Marcia lævigata and Tellina decussata were found.

Digitized by Google

A detour among the sandhills was now made, when Mr. J. G. O. Tepper, F L.S., explained their formation and the fixing of the loose sand by the roots of various peculiar plants, such as Spinifex hirsutus—(the "Spinifex" of explorers is a grass, Triodia irritans)—Scirpus nodosus, Lepidosperma gladiatum, Aster axillaris, Styphelia australis, Kunzea pomifera, Myoporum parvifolia, &c., all of which were indicated. Other plants collected were Banksia marginata, Calocephalus Browni, Tetragonia implexicome, Atriplex cinerius, and Salicornia australis. Attention was directed to the uniform slope of the sheaoaks, indicating the prevalence of south-west winds.

TENTH EXCURSION—MONDAY, SEPTEMBER 1, 1884.

Thirty members started at 8.30 a.m. per special coach for Clarendon. The morning promised fair weather, but a heavy shower on arrival and the prospect of more to follow made it unadvisable to proceed, as was contemplated, to the botanically rich scrublands between Clarendon and Kangarilla. It was therefore decided to inspect and examine the river scenery along the Onkaparinga, east of the bridge, instead. After lunch a meeting was held, presided over by Mr. J. G. O. Tepper, F.L.S., at which one new member was elected; and then the members proceeded up the right bank under the guidance of Mr Tepper and Dr. Schmid. At the first bend it was observed that all the pines peculiar to the valley of the river —Callitris cupressiformis—had been cut down, and thereby the beauty and interest of the place much marred.

Attention was directed to the unequal denuding action of the atmosphere upon the alternating texture of the rocks, viz., micaceous and talcose shales and quartzites. The following were the more remarkable plants gathered (mostly in flower), the names of which, with a running commentary, were furnished by Mr. Tepper:—Styphelia virgata, serrulata, australis, fasciculiflora, Callistemon salignus, Melaleuca decussata, Accacia melanoxylon (the Blackwood, occasionally overloaded by the parasitic Loranthus linophyllus or Preissii), verniciflua, retinodes and obliqua, Anguillaria dioica, Cæsia vittata, Cymbonotus Lawsonianus, Microseris Forsteri, Spyridium microcarpum, Correa decumbens, Adriana quadridentata (female flowers just opening, male blossoms still immature), Glycine clandestina, Kennedya prostrata and monophylla, Hibbertia stricta, acicularis and fascicularis, Logania longifolia, Mesembrianthemum æquilaterale (depending in long festoons from some of the inacessible rockwalls), and Cassytha melantha, which spread over whole shrubs in an intricate network of

Digitized by Google

cords. Of orchids only Pterostylis nana, Caladenia carnea and difformis, Diuris palustris and maculata were observed. Of sedges only one specimen of Cladium mariscus was noticed along the river bank, but very many of the pretty Luzula campestris (in flower) on the hillsides.

At 4 p.m. the coach started homeward by way of Chandler's Hill, Happy Valley, and the South-road, pelting showers at times greatly marring the pleasure of the drive.

ELEVENTH EXCURSION—SATURDAY, OCTOBER 18, 1884.

Some 30 ladies and gentlemen assembled at the Railway Station, North-terrace, and proceeded by the 1.10 p.m. train to Belair, and from thence walked over the Government Farm or Park. The special object was the collection of Orchids, of which fifteen species were obtained, among which were Thelymitra grandis, T. longifolia (blue), T. antennifera (yellow), T. McKibinii (blood-red), Glossodia major (blue to white), and several Caladenias, among which latter a large one with white flowers and pink streaks may prove an addition to our flora. In the shade of the forest composed of red-gum (E. rostrata), white-gum (E. leucoxylon), and peppermint (E.odorata), were found plants of almost every temperate clime, as Gnaphalium Japonicum, Geranium Carolinianum (North America), Oxalis corniculata, Cape Dandelion (Cryptostemma lavendulacea), Sherardia arvensis, and numerous others to which Prof. Tate drew attention, as also to the fact that the vegetation of the scrub lands was very different from that of the Park, owing to the difference of soil and the moisture retained by it.

Wandering along the watercourse, and crossing the scrub lands at the foot of Steep Hill, the party passed into the gorge of the southern branch of Brownhill Creek, the passage of which was exceedingly rough. The most notable plant found here was Logania longifolia. In due time the members arrived at Mitcham, and returned to town by the tramcar, arriving about half-past 6 p.m.

EVENING MEETINGS.

FIRST EVENING MEETING—TUESDAY, APRIL 22, 1884.

This was held in the University, when about 60 ladies and gentlemen attended. Prof. Tate presided, and in his address reviewed the work done, advised that the proposed conversazione be postponed till they had better collections, and intimated that he was prepared to devote several evenings during the session to lectures on subjects he had made a special study.

After the Hon. Secretary, Mr. W. E. Pickels, F.R.M.S., had

Digitized by Google

read the correspondence, one new member was elected, and the announcement made that two excursions were being arranged for. Mr. J. G. O. Tepper, F.L.S., exhibited fresh specimens of two orchids, the earliest of the year, viz., Eriochilus autumnalis, from the Mount Lofty Ranges, and Prasophyllum despectans, from Clarendon, its only known station in the neighbourhood, where it was discovered by him a year or two ago; also a new sundew, Drosera aphylla, from the same locality, and a beautiful lichen from Kangaroo Island, Cladonia retepora.

Mr. E. Davies brought some pink rocksalt and crystals of selenite. Mr. W. Howchin, F.G.S., showed some microscopical preparations of recent South Australian Foraminifera, illustrating the genera Biloculina, Triloculina, and Quinqueloculina; and Mr. Pickels, F.R.M.S., exhibited a fine Phasma, Tropidoderes iodomus, and some spiders sent by Mr. Guest, of Balhannah. Prof. Tate then delivered an instructive lecture on the Australian Lamprey, Geotria australis, which was followed by an animated discussion.

SECOND EVENING MEETING—TUESDAY, MAY 20, 1884.

This was held at the University, North-terrace, when about 30 ladies and gentlemen attended, and Prof. Tate presided. The Hon. Secretary read some correspondence, and three new members were elected. A formal vote of thanks to Mr. Robertson was passed for his kindness in inviting the members to view his apiary.

A number of plants collected by Miss J. R. G. Rogers, some 200 miles north of Farina, were exhibited. Among them were Marsdenia Leichardti and Eremophila maculata.

Mr. W. Howchin, F.G.S.. showed under a microscope a number of micro-ichthyolites and other objects from the Tertiary beds underlying Adelaide, obtained from a bore in the Waterworks yard at Kent Town. An interesting specimen of an Aphrodite, or Sea Mouse, was shown by Mr. W. H. Baker, and some letters were read from America, Russia, Switzerland, and Germany desiring exchanges of entomological and botanical specimens.

The President then called upon Dr. Haacke to deliver his lecture on "How to Preserve Zoological Specimens." The lecturer explained that only the best spirit and pure water should be used; that at first weaker and gradually stronger mixtures should be used; that occasionally the glass with the specimen should be shaken, as the water tended to gravitate towards the bottom, and the spirit at the top, so that the lower part of the specimen was in danger of becoming damaged. Too many specimens should not be put into the same glass. A cordial

Digitized by Google

vote of thanks to the lecturer, and the exhibition of an Australian Ant-eater, or Echidna, terminated the proceedings.

THIRD EVENING MEETING—TUESDAY, JUNE 17, 1884.

Professor R. Tate, F.G.S., in the chair. About 60 ladies and gentlemen were present. Two new members were elected. Mr. T. C. Magarey, jun., showed a marsupial, popularly known as the mallee opossum, which was pronounced by Professor Tate as the only authenticated specimen of the species outside of New South Wales. The Hon. Secretary exhibited a number of galls from Eucalyptus leucoxylon.

Dr. W. L. Cleland, F.R.M.S., delivered a short lecture on the microscope, in which he explained the action of the eye in reference to that instrument, illustrated by diagrams as well as sketches on the blackboard, and indicated the use of the various parts of single and compound microscopes.

Mr. J. G. O. Tepper, F.L.S., then read a paper on the "Collection and Preservation of Entomological Specimens," denoting the various orders of insects, and how to catch, kill, and mount them. A discussion followed this lecture, succeeded by scientific gossip, and the examination of microscopical appliances and mountings brought for the occasion by Dr. Cleland.

FOURTH EVENING MEETING—TUESDAY, JULY 15, 1884.

This was held in the room over the Picture Gallery in the Institute Building, North Terrace. Some 50 ladies and gentlemen attended, and Prof. Tate, F.G.S., presided.

The Hon. Secretary exhibited a gall of the olive tree, and Dr. W. Haacke some specimens of pumice stones, collected by Mr. A. Zietz, the preparateur at the Museum, at Diego Garcia, one of the Chagos Islands, where they had been driven ashore a short time after the eruption at Krakatoa.

Prof. Tate then called upon the Rev. W. Howchin, F.G.S., to deliver his lecture on "What is a Foraminifer?" The lecturer explained the nature of the Foraminifera, where occuring, how classified, and how they were mounted for examination, illustrating the subject by numerous diagrams. The President at the close of the lecture tendered the thanks of the Section to the lecturer for his valuable and interesting paper.

FIFTH EVENING MEETING—TUESDAY, AUGUST 19, 1884.

A large number of ladies and gentlemen attended at the Royal Society's room, and Prof. Tate, F.G.S., presided.

Digitized by Google

Mr. T. C. Magarey, M.B., exhibited a number of shells, including a valve of the Pinna, or Razor Shell, covered with aviculæ or butterfly molluscs. Mr. W. H. Selway, jun., showed an interesting collection of coralline algæ, and a specimen of a brilliant species of Stigmodera. The Hon. Secretary showed galls of the golden wattle (Acacia pycnantha), and a remarkable specimen of a fungus mycelium taken from decaying timber in a cellar in Currie-street.

The President then vacated the chair, which was taken by the Rev. W. Howchin, F.G.S., whilst Prof. Tate proceeded to address the members on "How Plants are Fertilised," and "The Mode How to Preserve Herbarium Specimens." The lecturer explained the various modes in which fertilization was brought about, especially noticing the provision in nature to prevent self-fertilization of plants. On preserving specimens the lecturer said a large amount of care had to be exercised in the collecting, and that the specimens must be dried between sheets of paper without the use of any hot iron. Exhibiting his own collecting case and travelling press, the Professor explained their working, and said that he would always be glad to assist the members in their botanical investigations. After showing some microscopical slides illustrating the structure of plants the proceedings terminated with a vote of thanks to the lecturer.

SIXTH EVENING MEETING—TUESDAY, SEPTEMBER 16, 1884.

The meeting was held in the Royal Society's room, in the Institute. About 70 ladies and gentlemen were present. Prof. Tate, F.G.S., in the chair. Mr. G. Mayo, F.R.C.S., exhibited some lizards from Hergott Springs, which Prof. Tate stated were a species of Grammatophora, or some allied genus. Mr. S. G. Magarey, M.B., a number of shells (Bulimus imbricata), and Helix Bednalli found near Stirling. Mr. R. H. Pulleine showed the nest of a trapdoor spider found near Hackney and Mr. H. A. A. Dombrain a rare Australian bird (Pratincola australis), at home in the deserts of the interior, but occasionally migrating southward to the coast. Mr. Tepper, F.L.S., exhibited Eriostemon pungens and a showy species of Aster (teretifolius) found growing near the highest ridges of the Mount Lofty Range. A number of dried plants brought from the South-East were shown by Mr. A. Molineux, among which were some specimens of the poisonous Swainsona, and canes of the "bulb-oak" (Casuarina suberosa?)

Mr. R. L. Mestayer, C.E., F.R.M.S., delivered a very instructive lecture on "Mounting Objects for the Microscope," in which he described some of the most useful methods em-

Digitized by Google

ployed, and enumerated the appliances necessary to ensure success. At the conclusion the members evinced their appreciation by long and continued applause.

Mr. H. C. Mais, C.E., brought for examination a number of microscopic slides received from America, for which purpose Mr. F. Wheeler had kindly lent a number of Armstrong microscopes.

SEVENTH EVENING MEETING—TUESDAY, OCTOBER 21, 1884.

A considerable number of members were in attendance, Mr. W. Howchin, F.G.S., in the chair. Prof. R. Tate, F.G.S., delivered a lecture on the "Jaws and Tongues of Snails," in which he explained their very curious structure, illustrating the subject by diagrams, and by the aid of some fresh specimens showed how to dissect the organs for microscopical examination. Referring to the common black slug (Limax maximus), he said it was possessed of the extraordinary number of 28,960 teeth.

At the close of the lecture, which was listened to with great interest, the Chairman announced that the annual meeting would be held at the present meeting instead of on the 28th, as had been advertised, when the following report was read by the Hon. Secretary :—

ANNUAL REPORT.

The Field Naturalists' Section of the Royal Society was inaugurated at a meeting held on November the 13th, 1883, and the following officers were elected to control its affairs :—

CHAIRMAN :
Professor Tate, F.G.S., F.L.S.

VICE-CHAIRMEN :
Mr. H. T. Whittell, M.D., F.R.M.S.
Mr. W. Howchin, F.G.S.

COMMITTEE :
Mr. W. L. Cleland, M.B., F.R.M.S.
" H. Dean
" W. Haacke, Ph.D.
" G. F. Hussey
" A. Molineux
" W. H. Selway, jun.
" J. G. O. Tepper, F.L.S.

TREASURER :
Mr. Geo. Collis, jun.

HON. SECRETARY :
Mr. W. E. Pickels, F.R.M.S.

Digitized by Google

Though only in existence twelve months, there are 165 members on the roll.

There have been eight half-day and three whole-day excursions in connection with the Section, all of which were well attended, and very gratifying in results.

The syllabus for the winter session embraced nine papers by distinguished Fellows of the Royal Society of South Australia on various subjects intimately connected with Natural History.

The interest exhibited by Professor Tate in the formation of the Section and in the work undertaken by its members has greatly stimulated the efforts of scientific students, and there is every probability that the Section will ultimately be of considerable service to the parent Society, the Fellows of which have so kindly fostered and encouraged it.

POSTAL MICROSCOPICAL SECTION

OF THE

Royal Society of South Australia.

W. E. PICKELS, Hon. Secretary.

A box of miscroscopical objects has been received from Victoria and duly circulated among the members of this Section, and a box of South Australian objects has been made up in this colony and forwarded to Victoria and New South Wales.

Digitized by Google

FIELD NATURALISTS' SECTION OF ROYAL SOCIETY OF S.A.

ANNUAL BALANCE-SHEET, 21st OCTOBER, 1884.

Dr.	£	s.	d.	Cr.	£	s.	d.	£	s.	d.
Oct. 1, 1883.—To Grant from Royal Society ...	10	0	0	Oct. 1, 1883.—By Hire Town Hall ...	3	10	0			
Jan. 1, 1884.— " " " ...	20	0	0	" " " Expenses therewith	1	0	0			
Aug. 1, 1884.— " " " ...	20	0	0	" " " Petty Cash to Sec. ...	2	0	0			
				" " " Advertising Crafers	0	11	6			
				Jan. 1, 1884.— " Loss on Hallet's Cove Expedition ...	1	12	6			
				Feb. 23, 1884.— " Sherring & Co.— Printing	13	15	0			
				Aug. 20, 1884.— " Ditto...	11	14	0			
				" Postages	9	5	0			
				" *Register*, Printing, 8s.; Petty Cash, 12s. ...	1	0	0			
								44	8	0
				Balance in hand of Treasurer				5	12	0
	£50	0	0					£50	0	0

Audited and found correct.

W. J. EVANS,
JOHN T. BISHOP, } Auditors.

Adelaide, 20th October, 1884.

W. E. PICKELS, Hon. Secretary.
GEORGE COLLIS, JUN., Hon. Treasurer.

Digitized by Google

LIST OF MEMBERS

OF

FIELD NATURALISTS' SECTION

OF THE

ROYAL SOCIETY OF SOUTH AUSTRALIA.

Those names marked † are Fellows of the Royal Society, S.A.
Those names before which the letter F appears are foundation members.

†FAdamson, Mr. D. B., Angas-street, Adelaide.
FAdamson, Miss S., Angas-street, Adelaide.
FAdcock, Mr. D. J., Currie-street, Adelaide.
Addison, Mr. H. M., King William-street, Adelaide.
FAitken, Mr. J., Parkside.
Bailey, Mr. W., Smith & Parker, Hindley-street, Adelaide.
FBaker, Mr. W. H., 34, King William-street.
Bakewell, Mr. E. W., Elder's Wool Co., Adelaide.
Barker, Miss, St. John's Wood, Nailsworth.
FBathurst, Mr. F., *Register* Office, Adelaide.
Beazley, Mr. Geo., The Museum, Adelaide.
Beresford, Mr. D. J. D., Parliament House, Adelaide.
Best, Mr. D. (Hon. Memb.), 16, Little Collins-street E., Melbourne.
Bevilaqua, Mr. L. W., Melbourne-street, North Adelaide.
FBeythien, Mr. E., Moonta.
Birks, Mr. G. F., 59, Rundle-street, Adelaide.
FBishop, Mr. J. F., Union Bank, Adelaide.
Blair, Mr. J. B., Port Adelaide.
FBottomley, Mr. W. D., Savings Bank, Adelaide.
FBoulger, Professor, University, Adelaide.
Bowcher, Mr. J., The Museum, Adelaide.
Bowen, Mr. F. C., Freeman-street, Adelaide.
Brady, Mr. J. W., Olive House, Edwardstown.
Brook, Mr. W. J., J.P., King William-street, Adelaide.
Brown, Mr. T. G., King William-street, Adelaide.
†FBruer, Mr. J. J., King William-street, Adelaide.
†Bussell, Mr. J. W., F.R.M.S., Railway Station, Adelaide.
FCalf, Mr. P., Public Works Office, Adelaide.
FCarey, Mr. T. C., Waymouth-street, Adelaide.
FCargeeg. Mr. G. H., 87, King William-street, Adelaide.
Chipp, Mr. H. E., King William-street, Adelaide.
†FCleland, Dr. W. L., Parkside.
Cleland, Mrs. W. L., Parkside.
FCollis, Mr. G., jun., Gawler-place, Adelaide.
Coppin, Mr. E., Rundle-street, Adelaide.
Cornack, Mr. T., The Museum, Adelaide.
FDancker, Mr. F. W., Grenfell-street, Adelaide.
FDane, Mr. F. N., Eliza-street, Waymouth-street, Adelaide.
†FDavies, Mr. E., Currie-street, Adelaide.

Digitized by Google

Dr. C., Davies, Beaumont.
rDean, Mr. H., Carrington-street, Adelaide.
Dixon, Mr. I., Ashley-street, Gover-street, North Adelaide.
Dixon, Mr. S., c/o Luxmoore & Co., Limited, Adelaide.
†rDobbie, Mr. A. W., Gawler-place, Adelaide.
Dombrain, Mr. H. A. A., Knightsbridge.
Dowie, Mr. A., Wakefield-street E., Adelaide.
Edmeades, Mr. T. A., National Bank, Adelaide.
†rEvans, Mr. T., King William-street, Adelaide.
rEvans, Mr. W. J., National Bank, Adelaide.
rFabian, Mr. T., City Treasurer, Adelaide.
rFarrar, Mr. G. E., C.E., Victoria-square, Adelaide.
rFleming, Mr. D., Mackinnon-parade, North Adelaide.
†rFletcher, Rev. W. R., M.A., North-terrace, Kent Town.
Fornachon, Mr. C. L. F., Y.M.C.A., Adelaide.
Franklin, Mr. Geo., Edward-street, Norwood.
rFrayne, Mr. N., c/o Messrs. D. & W. Murray, Adelaide.
rFrench, Rev. S., M.A., Glenelg.
rFryer, Mr. C., Melbourne-street, North Adelaide.
rFuller, Mr. W., University, Adelaide.
†Gall, Mr. D., Tynte-street, North Adelaide.
Gallagher, Mr. W. E., Kadina.
Gee, Mr. L. C. E., c/o Surveyor-General's Department, Adelaide.
Grasby, Mr. W. C., Oakbank.
Guest, Mr. E. (Hon. Memb.), Balhannah.
Gurner, Mr. J. R., North-terrace, Adelaide.
rHall, Mr. T. G., Edshall-street, Norwood.
Hammond, Mr. H., Childers-street, North Adelaide.
rHampson, H., Leigh-street, Adelaide.
Harvey, Miss, Parkside.
rHaslam, Mr. J., C.E., Pirie-street, Adelaide.
Hill, Mr. C., Alix House, South-terrace, Adelaide.
Hill, Mr. W. H., South-terrace, Adelaide.
rHooper, Mr. W. C., Hindley-street, Adelaide.
†rHowchin, Mr. W., F.G.S., Goodwood E.
Howell, Mr. F. I., H.M. Gaol, Adelaide.
Howell, Mr. Geo., Pirie-street, Adelaide.
rHunwick, Mr. Charles, Hindmarsh.
rHussey, Mr. G. F., G.P.O., Adelaide.
Jacobs, Mr. Geo. W., Currie-street, Adelaide.
Jacques, Mr., Dr. Robertson, North-terrace, Adelaide.
Jameson, Mr. Geo. E., Union Bank, Adelaide.
Kelsey, Mrs., Palm-place, Hackney.
†Kelly, Rev. R., Port Adelaide.
Kirby, Mr. E., Farina.
†Knight, Mr. G. C., Durstan House, North Adelaide.
†rLamb, Professor H., M.A., University, Adelaide.
Lawrance, Mr. V., J.P., Lefevre-terrace, North Adelaide.
Lawrance, Mr. C., Lefevre-terrace, North Adelaide.
Lawson, Mr. J. D., Divett-place, Adelaide.
rLeader, Mr. C. S., King William-street, Adelaide.
†Leary, Mr. J. L., M.A., South-terrace W., Adelaide.
Light, Mr. W., Wentworth, N.S.W.
Lindow, Mr,, Messrs. J. S. Sanders & Co., Hindley-street, Adelaide.
rLlewellyn, Mr. R., Riverton.
rLocke, Mr. E. H., *Register* Office, Adelaide.
Lucas, Mr. R. B., King William-street, Adelaide.
†rMagarey, Dr. S. J., North-terrace, Adelaide.

Digitized by Google

Magarey, Mr. T. C., jun., Waymouth-street, Adelaide.
Manthorpe, Mr. C. E., National Bank, Clare.
Marshall, Mr. A. W., 52, Rundle-street, Adelaide.
rMatters, Mr. C. H., Victoria-square, Adelaide.
rMatters, Mr. T. J., Victoria-square, Adelaide.
†rMayo, Mr. G. G., Morphett-street, Adelaide.
McCallum, Mr. S. J., 71, King William-street, Adelaide.
rMcEwin, Rev. J., Medindie.
McKenzie, Mr. I., G.P.O., Adelaide.
McLean, Miss, Prospect Hall, North Adelaide.
Meggy, Mr. P. R., c/o *Advertiser* Office, Adelaide.
†rMestayer, Mr. R. L., C.E., F.R.M.S., Hydraulic Engineer, Adelaide.
rMilford, Mr. J. S., B.Sc., Pirie-street, Kent Town.
rMillar, Mr. A. P., Waymouth-street, Adelaide.
†rMohan, Mr. J. H., Crafers.
†rMolineux, Mr. A., Kent Town.
rMolineux, Mr. A. E., Kent Town.
Moore, Miss F., Telegraph Office, Adelaide.
†rMunton, Mr. H. St., North-terrace, Adelaide.
rMyers, Mrs., Halifax-street, Adelaide.
rNelson, Mr. G., 59, Rundle-street, Adelaide.
Newman, Mr. J. H., 12, Currie-street, Adelaide.
Packer, Mr. G., Rundle-street, Adelaide.
Page, Mr. H. J., Mitcham.
†Parker, Mr. T., C.E., St. Vincent's Chambers, Port Adelaide.
rPeatt, Mr. R., Nailsworth.
Penney, Mr. J. Kemp, Bank-street, Adelaide.
Phillips, Professor, M.A., University, Adelaide.
Phillips, Mr. E., Telegraph Office, Port Adelaide.
†rPickels, Mr. W. E., F.R.M.S., Box 128, G.P.O., Adelaide.
Poole, Mr. W. B., Savings Bank, Adelaide.
†rPoulton, Dr. B., Adelaide Hospital, Adelaide.
Pullein, Mr. R. H., King William-street, Kent Town.
Read, Mr. A. W., The Museum, Adelaide.
Read, Mr. Geo. A. G., Telegraph Office, Adelaide.
Roberts, Mr. J. P., Victoria-square, Adelaide.
Robertson, Mr. J., Angas-street, Adelaide.
Robertson, Dr. W., North-terrace, Adelaide.
Robin, Miss, St. Jacques, Flinders-street, Kent Town.
Robin, Mr. A. B., St. Jacques, Flinders-street, Kent Town
rRogers, Mr. A. L., 3, Rundle-street, Adelaide.
Rosenhain, Mr. O. W., Box 11, G.P.O., Adelaide.
Saint, Mr. E., Ward-street, North Adelaide.
rSansom, Mr. P., Currie-street, Adelaide.
Scoular, Mr. J., Union Engineering Co., Adelaide.
rSelway, Mr. W. H., jun., The Treasury, Adelaide.
rShapter, Mr. W. T., King William-street, Kent Town.
†Smeaton, Mr. S., B.A., Bridgeport.
rSmeaton, Mr. T. H., Flinders-street, Adelaide.
Smith, Mr. G. W., Port Adelaide.
rSmith, Mr. T. J. S., Mackinnon-parade, North Adelaide.
rSmith, Mr. W., Stephens-place, Adelaide.
rSowden, Mr. W. J., *Register* Office, Adelaide.
†rStirling, Dr. E. C., M.A., Lefevre-terrace, North Adelaide.
rSunter, Mr. J., J.P., Messrs. J. Colton & Co., Adelaide.
†rTate, Professor, F.G.S., F.L.S., Dawesley, Nairne.
rTate, Miss, Dawesley, Nairne.
Taylor, Mr. G., South-terrace, Adelaide.

Digitized by Google

rTepper, Mr. J. G. O., F.L.S., Somerset-place, Norwood.
rThomas, Mr. W. K., *Register* Office, Adelaide.
†Thomson, Mr. R., *Register* Office, Adelaide.
Thwaites, Mr. F. J., National Bank, Adelaide.
†Todd, Mr. C., C.M.G., Postmaster-General, Adelaide.
rTucker, Mr. H. J., Model School, North Adelaide.
†Varley, Mr. A. K., Kirtonville, Mount Gambier.
rWaddy, Mr. R., G.P.O., Adelaide.
†Wainwright, Mr. E. H., Collegiate School of St. Peters, Hackney.
Walker, Mr. A., Y.M.C.A., Adelaide.
Watts, Mr. H. (Hon. Memb.), Wellington-street, Collingwood, Melbourne.
rWhatham, Mr. F. G., Freeman-street, Adelaide.
rWhitmore, Mr. S. J., *Register* Office, Adelaide.
rWhitney, Mr. F. M., Messrs. J. Colton & Co., Adelaide.
†rWhittell, Dr. H. T., F.R.M.S., Astor House, New Glenelg.
rWilcox, Mr. S., 49, Rundle-street, Adelaide.
Willmott, Miss Amy, Glen Osmond.
Wilson, Mr. I., F.E.I.S., Goodwood.
Wilson, Mr. S. P., Uraidla.
Wiseman, Mr. A., Freeman-street, Adelaide.
Witherick, Mr. J., Waymouth-street, Adelaide.
Wordie, Mr. V. A., Flinders-street, Adelaide.
†Wragge, Mr. C., F.R.G.S., The Observatory, Torrens Bank, Walkerville.

Webb, Vardon, & Pritchard, Printers, Adelaide.

Digitized by Google

Digitized by Google

Digitized by Google

Digitized by Google

TRANSACTIONS AND PROCEEDINGS

AND

REPORT

OF THE

ROYAL SOCIETY of SOUTH AUSTRALIA.

VOL. VIII.

(FOR 1884-5.)

ISSUED MAY, 1886.

Adelaide:
G. ROBERTSON, 103, KING WILLIAM STREET.

1886.

Parcels for transmission to the Royal Society of South Australia, from Europe and America, should be addressed "per W. C. Rigby, care Messrs. Thos. Meadows & Co., 35, Milk Street, Cheapside, London."

Webb, Vardon, & Pritchard, Printers, Gresham street, Adelaide.

Digitized by Google

Digitized by Google

TRANSACTIONS AND PROCEEDINGS

AND

REPORT

OF THE

ROYAL SOCIETY of SOUTH AUSTRALIA.

VOL. VIII.

(FOR 1884-5.)

ISSUED MAY, 1886.

Adelaide:
G. ROBERTSON, 103, KING WILLIAM STREET.

1886.

Parcels for transmission to the Royal Society of South Australia, from Europe and America, should be addressed "per W. C. Rigby, care Messrs. Thos. Meadows & Co., 35, Milk Street, Cheapside, London."

Digitized by Google

Royal Society of South Australia.

Patron:
HER MAJESTY THE QUEEN.

Vice-Patron:
HIS EXCELLENCY SIR WILLIAM ROBINSON, K.C.M.G., C.B., &c.

OFFICERS.

[Elected October 6, 1885.]

President:
H. C. MAIS, Esq., M.I.C.E.

Vice-Presidents:
WALTER HOWCHIN, Esq., F.G.S. (Editor),
RICHARD L. MESTAYER, Esq., C.E.

Hon. Treasurer:
WALTER RUTT, Esq., C.E.

Hon. Secretary:
W. L. CLELAND, Esq., M.B.

Other Members of Council:

PROFESSOR RENNIE, D.Sc., F.C.S.
H. T. WHITTELL, Esq., M.D. (Representative Governor)
E. C. STIRLING, Esq., M.D.
J. W. BUSSELL, Esq.
D. B. ADAMSON, Esq.
W. E. COOKE, Esq., B.A.

Assistant Secretary:
MR A. MOLINEUX.

Digitized by Google

CONTENTS.

PAGE.

J. J. East: On a Geological Section from the Head of St. Vincent Gulf Eastward across the Wakefield and Light River Basins (plate i.) .. 1

Ch. Winnecke: Plants collected in Central Australia 10

Samuel Dixon: Remarks on some Indigenous Shrubs of South Australia suitable for Cultivation as Fodder 14

W. A. Jones: Notes on Iridescent Clouds 28

Gavin Scoular: Past Climatic Changes, with special reference to the occurrence of a Glacial Epoch in Australia 36

Prof. R. Tate: Post-Miocene Climate in South Australia 49

E. Guest: Remarks on the Nomenclature of some South Australian Butterflies, with Observations 60

W. T. Bednall: Description of and Notes upon the Species of the Genera *Murex* and *Typhus*, known and recorded as existing on the Coast of South Australia.. 63

W. Ernest Cooke: A few Remarks about Weather Forecasting for South Australia 67

Prof. R. Tate: Additions to the Flora of Extra-Tropical South Australia, including Descriptions of Two New Species 71

Prof. H. Lamb: On the Persistency of Electric Currents in Masses of Iron.. 73

Prof. H. Lamb: The Cause of the Luminosity of Flame 74

F. S. Crawford: The Apricot Disease 77

Walter Howchin: On the Fossil Foraminifera from the Government Boring at Hergott, with General Remarks on the Section, and on other forms of Microzoa observed therein 79

Prof. Tate: Supplemental Notes on the Palliobranchs of the Older Tertiary of Australia, and a description of a New Species of Rhynchonella (plate vi.) 94

Prof. Tate: The Lamellibranchs of the Older Tertiary of Australia, Part I. (plates ii. to xii.) 96

Digitized by Google

MISCELLANEA.

The Dasyurus, a (?) Vegetarian—A. Molineux 159

Fungi Collected near Clarendon—J. G. O. Tepper .. .. .. ib.

Plants Collected near Stuart's Range in 1885—Chas. Winnecke .. 160

On the Occurrence of *Astrorhiza angulosa* as a Fossil in the Older Tertiary of Victoria—W. Howchin .. .. ib.

Bibliographical Notices: Australian Fossil Bryozoa 161

Notes on Some Mesozoic Plant Remains from South Australia 163

Abstract of Proceedings 164

By-Laws Relating to Sections in connection with the Society 169

Balance-sheet 170

Donations to the Library 171

List of Fellows, Members, &c. 177

APPENDIX.

Proceedings of Field Naturalists' Section 180

Digitized by Google

On a Geological Section from the Head of St. Vincent Gulf Eastward across the Wakefield and Light River Basins.

By J. J. East.

Plate I.

[Read November 4, 1884.]

INTRODUCTORY.

The sectional line here spoken of extends from Port Wakefield across the Wakefield Plains, and through the Adelaide chain of the Flinders Ranges to their eastern slopes overlooking the valley of the Murray River.

The form of the ground's surface naturally suggests its division into two portions, viz., a level or gently undulating plain reaching back from the waters of the gulf for 22 miles, when it gives place to a tract of hilly country. This hill region is formed by a succession of parallel ranges having a nearly meridional strike, and separated from each other by valley-plains often of considerable extent. The ranges as a rule appear about the same average height above the plains, but on a line from west to east they really, with the valleys between, form a series of terraces, each valley and range on the east having a greater absolute elevation than that on the west. The eastern range is the highest of all, the summits of several points being over 2,000 feet above the sea. It forms a wide-topped swell many miles long, and is known as the tableland. From the eastern slope of the tableland the surface of the country falls rapidly towards the Murray River, but no long creeks nor permanent waters exist in the 35 miles of scrub and plain which intervene between that channel and the hills.

In consequence of the terraced formation of the hill country the whole of the surface drainage is towards the gulf, the western ranges being drained by the River Wakefield, and the central and eastern ones by the Light and its tributary the Gilbert.

THE WAKEFIELD PLAINS.

In describing the series of beds or strata met with along the line of section it will be advantageous to begin with the western or "plains" portion.

On the edge of the gulf at Port Wakefield a deep borehole

Digitized by Google

sunk by the Government has revealed a great thickness of Tertiary beds resting directly on a primary rock composed of blue slate containing iron pyrites and bands of quartz. The Tertiary beds have been critically discussed by Professor Tate in Vol. IV. of the Society's Transactions, &c., and by him the series are divided into two portions, the upper beds being classed as "Recent Marine" and the lower beds "Pliocene Drift."

The Recent Marine does not extend far inland, and is succeeded on the surface by red loam, underlaid by red clay, which continues to Balaklava. Sinkings at this place pierce the loam and clay at about 80 feet, and then enter water-bearing strata of sand and gravel. The same occurs at Halbury on the Blyth railway line, and at several points in the scrub south of Balaklava. East of this township the red loam is found surmounted by a crust of travertine, and this in turn is covered by 20 to 30 feet of blown sand of a light-brown colour. It is this sand which by forming mounds gives the undulating character to the plains. A fine section of the sand, travertine, and loam is exposed by a railway cutting on the Blyth line just over the bridge crossing the Wakefield. These sandhills continue right back to the ranges, and where they adjoin the older rocks often develop flat beds of a fine-grained brownish-black ferruginous sandstone, which is extensively used for road metal. The manner of its occurrence is like that of travertine, and doubtless owes its origin to similar causes—aqueous solutions concentrated by evaporation.

Along the line of section no exploration has been made deeper than the gravel which underlies the red clay, but at several points southward the search for water has resulted in greater depths being reached. The Hundreds of Dalkey and Grace are by this means pretty well known, but in no instance have the wells reached the primary rocks. Among the sandhills west of Owen railway station wells which have been sunk over a tract of country six miles wide have passed through the gravel and entered blue clay at a general depth of a little over 100 feet from the surface. Twelve miles farther south in a well at Mallala—115 feet above sea level—the blue clay was met with at a depth of 80 feet. The water supply at this depth being insufficient and of poor quality, a borehole was continued from the bottom. The blue clay continued to a depth of 150 feet further, and then the drill entered a bed of quicksand and gravel, which afforded water with such pressure that it not only rose to the top of the bore, but flooded the well to a depth of 40 feet, at which point the water has found its level, or, what is more probable, the lateral soakage is equal to the supply from below. This well was sunk by the Milling Company for

Digitized by Google

engine purposes, and the water derived is eminently suitable for such uses, being clear and soft.

Where the plain slopes up to the foot of the hills the red clay or loam is found resting directly against the primary rock, and the river channels where they debouche on the plain show only a section of this upper bed or the overlying sand and travertine. Summarised, therefore, the strata of the plain consist in descending order of—

Blown sand	30 feet
Travertine	2 "
Loam and red clay	80 "
Sand and gravel, with brackish water .	2 "
Blue clay	150 "
	264 feet

Quicksand and gravel, with abundance of good water.

THE HILLS.

The rocks composing the hill country are divisible into three groups, each unconformable to the others. The newest formation is a gritty sandstone, often a ferruginous conglomerate or breccia. The coarser portions occupy the lowest levels, and from this the transition is a gradual approach to a lighter-coloured and finer-grained sandstone, which forms a cap to almost all the ranges. No fossils have been detected in it, and has been referred to various geological ages, from Miocene to the Desert Sandstone. Extensively distributed, it is also very thick. At Macaw Creek, south of Rhynie, it forms round-backed hills 200 feet high. In the valley of the Light, between Hamilton and Anlaby, it is also greatly developed. The most extensive and unbroken series of it is met with on the Alma range, where it forms a cap and flanking formation all the way from Stockport to Saddleworth. As might be inferred, the nature of this rock varies greatly, especially the upper portions. In some places, as near Undalya, it is a coarse soft sandstone; at Rhynie and west of Stockport it is quarried as a white freestone for building purposes. At Stockport itself and near Marrabel its ferruginous beds yield splendid tough road metal. On the Marrabel range it is compact, grey, hard, and barely distinguishable lithologically from the grey quartzite forming the core of the range.

The best exposure of this series is seen at Stockport, on the bank of the River Gilbert. There the western side of the channel is formed of very coarse conglomerate, consisting of quartz stones (some of them being as large as one's fist) cemented together by a ferruginous paste. The Gilbert has cut a channel through it, and passing westward it is seen at

Digitized by Google

length bounded by slates dipping eastward. Ascending these slates, the sandstone cap is found to get finer and finer grained until, as before stated, it becomes a freestone quarried for building purposes. Where not resting directly on primary rocks this sandstone rests on blue clay similar in appearance to that found under the red clay of the plains. Such is the case at Tothill's Creek, Butcher's Gap, Woolshed Flat, Salter's Springs, and Humphrey's Springs.

The frequent occurrence of similar patches of conglomerate in the beds of creeks which are still the main drains of the tract of country in which they are situated would at first sight appear to indicate that the sandstone just spoken of had its origin in running streams. The bedding of the sandstones, however, their dip and variation in texture, while indicative of formation by currents is not consistent with lacustrine or river depositions when considered in the light of their altitudes and distributions over extensive areas.

PRIMARY ROCKS.

The series of slates, quartzites, and crystalline limestones forming the main mass of the ranges have been tentatively classed under the somewhat ambiguous term of "pre-Silurian," which term, however, commends itself as being indicative of the extreme age to which these rocks undoubtedly belong. Along the line of section they are clearly divisible into two groups—an upper and lower—both upheaved and greatly faulted, and unconformable to each other.

Upper Group.—The upper group is much the thicker of the two, and consists of slates, soft aluminous rock, quartzites, flags, and sandstones. It is seen to best advantage in the Gilbert Valley along the line of section which passes through Riverton. In descending order the rocks here met with are

Greenish grey sandy slates and soft aluminous rock.
Pink and brown earthy slates.
Blue slates containing black iron pyrites.
Olive green slate.
Brown quartzite.
Olive green sandy slates.
White slatey sandstones, soft and sometimes earthy.
Blue flags.
Bluish grey sandstones graduating into micaceous flags.

All the above beds are seen in ascending order from about one mile west of Riverton to the foot of the Marrabel range, about four miles further east. The prevailing strike is N. 10 W. and dip eastward at a mean angle of 23 deg. from the horizon. Numerous quarries abound in the three lowest beds

Digitized by Google

which are worked locally, and furnish the building stone, flags, and road metal required in the neighbourhood.

Two miles south of the town the pyritiferous slates form a hard brown ferruginous shale, which constitutes a round-back swell of about half a mile in length. This change is probably due to the oxidation of the pyrites as they at times are found studding this rock like currants in a cake. The same rock is seen in the Light channel, about three miles below Hamley Bridge, and from it I have gathered pyrites which, while externally of a clear black colour, were of the original brass yellow towards the centre. At several other places the shale occurs on the alignment of the slate, among others at Dorrington's farm on the Marrabel range, where it is scarcely one hundred yards from the unaltered bed. Paddy's Knob (in the Northern Areas) on the Germein road near Wirrabara is another instance of this localisation of chemical changes.

The two upper beds of this group contain much soluble matter, and when treated with hydrochloric acid the pink variety loses one-third of its weight. Their soft, almost friable, nature and susceptibility to chemical action is the cause of their always weathering into rolling swells with sometimes deep watercourses at their bases. North-east of Tarlee the valley is deeply cut up from this cause.

About four miles east of Riverton a fault of upthrow occurs, which brings the lowest beds again to the surface. The beds appear to be somewhat thicker also, which, though doubtless is the case, is yet made more apparently so by the dip of inclination being lessened several degrees.

The Marrabel range presents its steepest face to the west, and has undergone denudation in a very irregular manner, due principally to the varying hardness of the Tertiary sandstone by which it is capped. The blue flags are seen at the fault which passes by Ettrick's ruined church. The olive green slates occur at the foot of the range; the brown quartzite at intervals shows bare on its summit, and half-way down the other side is a quarry in the pyritiferous blue bed which has supplied the stone to build Marrabel. The next four miles is covered by the Tertiary sandstone, and the sequence of the rocks is ascertained by wells and exposures of rock at greatly denuded points north and south of the sectional line.

Another fault in this upper group of rocks is marked by the Julia range. From here to the table-land the strata are much disturbed and occasionally the angle of dip is very high and always easterly. The table-land range, however, dips westward, and must therefore form a synclinal trough under the upper portions of Julia and Pine Creeks. The eastern face of the table-land presents a steep and sometimes bluff face, over-

Digitized by Google

looking the Murray Plains, due to its having been faulted upward from that side. This last fault is a very long one, and runs in a general direction of N.N.W. and S.S.E. from Robertstown to Leake's Lookout, a distance of over 20 miles.

From Eudunda, which stands nearly on the line of fault, the surface of the country falls rapidly towards the Murray. A few swells, mostly of sandstone, appear, and in the railway cutting at Mount Mary the last of the Primary slates are seen. After this the fossiliferous beds of the Murray basin occupy the country further eastward.

Lower Group.—What I have termed the "lower group" of rocks forms the base of the western ranges, and consist of beds of slates, crystalline limestones, and quartzites. Nowhere, as far as my observations have extended, are they exposed in full succession except so far as the lower beds are concerned. The whole series is much faulted and disturbed, and the strike and dip very variable, but the latter is always at a high angle. As the results of numerous observations I have been led to accept the following as the sequence of the different beds in descending order:—

Grey talcose slate.
Grey quartzite.
Hard blue shale.
Crystalline thin bedded limestone with talc partings.
Siliceous thin bedded marbles.
Olive-green slate.
Brownish-white sandstone.
Green and grey sandy slates.
Thick bedded grey quartzite.
Yellowish clay slate.
Massive quartzite breccia.

Although, as previously stated, the strike of particular beds is never constant, the series as a whole has a general direction of N.N.W. and S.S.E. It forms the base of the Alma Range from Stockport to the River Wakefield, and of the Skilly ranges from the Wakefield to Clare. The road which runs west of the Clare hospital has a goodly proportion of marble in the metalling. The watercourses of the Skilly ranges have eroded channels through the softer slates and limestones, and in consequence the harder quartzites and sandstones remain standing in a series of narrow high parallel ridges which effectually shut out any direct traffic from Watervale or Leasingham to the plains on the westward.

Between the Skilly ranges and the main North Railway the ground is formed by rocks of the "upper group." The upheaval of the Skilly ranges from the westward has subjected

Digitized by Google

these beds to tremendous lateral compression, by which they were thrown into a series of folds, the culminating point being Mount Horrocks. In the immediate neighbourhood of Auburn the foliation is clearly displayed by the road cuttings. Four miles eastward the Pine Creek has worn its channel completely through the slates of the upper group down to the crystalline limestone of the "lower group." The exposure of limestone at this point was observed by Prof. Selwyn in 1859, when driving from Saddleworth to Auburn. A few yards to the westward is a dyke of dolerite, which is the only eruptive rock I have observed in this district, but I am informed that fragments have been found in the Skilly ranges, near Clare, by Professor Tate. Professor Selwyn records the occurrence of a granite dyke at the confluence of the Julia and River Light, about four miles south of the section. At Pine Creek this rock is quarried for road metal.

Between Riverton and Rhynie some of the weathered boulders of marble become deeply stained with iron oxide, and have a suggestive coralline appearance, and when an unweathered fragment is ground smooth the mass is seen to be composed of shot-like concretions cemented together. Specimens of this rock have been submitted to Prof. Tate and the Government Geologist, but were not recognised as organic formations. The same rock is traceable as far south as Stockport, beyond which the rocks disappear beneath Tertiary deposits; but at Templers, nine miles from Gawler, the debris from the well is talcose slate, similar to that found in other places occupying the highest position in the "lower group" series. The Alma plain is loam and drift resting on rocks of the "upper group," and is bounded on the west by the low Dalkey Range. At Stockyard Creek the wells show talcose slate as at Dry Creek, west of Tarlee. The dip is easterly, and passing west to the Wilderness Creek, near Owen, there is an exposure of the limestones, also dipping east. Seven miles north of this, where the Wakefield River forces its way through a gap on to the Wakefield Plains, the sequence of the rocks is again observable in the natural section there formed. This Dalkey Range, though much lower in altitude, is the counterpart of the Alma Range on the east—a base of Primary rocks capped with Tertiary sandstone. The beds of the "upper series" resting between those two ranges show much false bedding, and along the Hermitage Creek—under the flank of the thick quartzites—are distinctly inverted.

Stockyard Creek is the most southern point of the "lower group" in Dalkey. The rocks of the upper group seem to flank it on the east and south, while Tertiary deposits bound the western side. The channel of the Light from Hamley Bridge

Digitized by Google

to Redbanks show only a section of greatly faulted beds belonging to the "upper group."

SUMMARY.

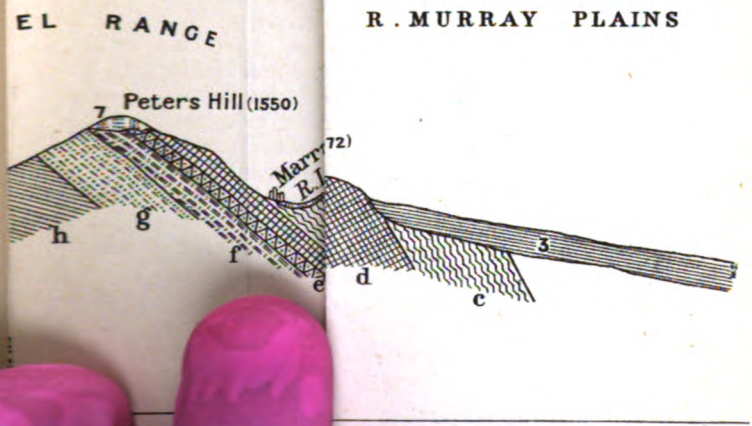
To summarise the observations made on the two Primary groups, the whole district may be considered as formed of slates and sandstones (upper group), broken up on its western edge by upheaved limestones, slates, and quartzites. The varying dip and strike, great metamorphism and faultings, together with the presence of intrusive rock, characterising the "lower group," suggest that an immense period elapsed between the depositions of the "upper" and "lower" series. The lower group had been faulted and upheaved before the upper beds were deposited, and in the subsequent convulsions of nature the force which upheaved and faulted the whole country still further faulted the underlying limestone group.

The occurrence of the Tertiary sandstone capping the old Primary rocks is suggestive of its being a shallow water formation, and as a slow upheaval went on the products of denudation would necessarily gravitate into the lowest hollows —precisely as we now find them—and finally form the conglomerate beds so common in the different valleys. The eroding action of the watercourses have cut their channels through them where conditions were favourable, leaving the conglomerate beds in patches on the flanks or slopes of hills overlooking the valley. Where, then, a conglomerate patch exists above a watercourse, it bears silent testimony to the eroding influence of the stream below. Further than this, it testifies how very long a period has really elapsed since the dawn of what we still call "recent" geological time.

In the absence of palæontological evidence all identification of rocks based solely on their lithological features is open to a greater or less amount of doubt, but a faithfully recorded sequence of conformable strata in any one locality becomes a clue deserving consideration when examining neighbouring districts the topographical features of which suggest a relation thereto.

It has been shown that the upheaval of the western side of the Wakefield basin has had the effect of folding and faulting the beds of the upper group, producing the swells which by denudation of the softer portions now form the numerous parallel ranges extending northward. In the troughs of synclinal folds, or along the line of faults, the numerous creeks have worn deep channels, and owing to this circumstance, *i.e.*, the water following an indicated or ready-formed system of drainage, there are very few gorges or natural sections throughout the whole district.

Digitized by Google



Digitized by Google

Digitized by Google

What lies beneath the quartzites of the lower group is not visible in this district, but in the northern areas, at Tarcowie Springs, in the Appila Creek, a similar series of beds—which for the reasons just given I assume are identical with the Wakefield group—rest directly on mica schists, and both are pierced by a large dyke of porphyritic greenstone. The whole of the Pekina Range, extending as far north as Oladdie Station, seems identical in structure to the Wakefield basin—two unconformable series of beds, the one principally argillaceous, the other chiefly calcareous and siliceous. Between the Pekina and Wakefield beds lies the basin of the Broughton River, in which, according to Selwyn, the whole country is composed of one single series of rocks in anticlinal and synclinal undulations extending from Bundaleer to the foot of Mount Bryan. This series I have traced into direct connection with what I have termed the "upper group" in the foregoing pages, and despite the absence of fossil evidence the inference is a very strong one that the Pekina and Wakefield "lower group" rocks are identical. We have thus an axis of upheaval extending from the latitude of Port Augusta to the shores of St. Vincent Gulf quite distinct from that of the Hummocks and Mount Remarkable systems, and nearly on the central meridian line of the Flinders Range, when considered as a whole.

South of Kapunda the Adelaide chain has been so metamorphosed that lithological aspects on a large scale cannot be grouped in such a manner that the rocks shall of themselves bear the impress of identity, but the numerous references given by Selwyn indicate that the sequence of each conformable series will yet suffice to connect them with the two groups of the Wakefield basin.

EXPLANATION OF PLATE I.

The sectional line runs from Port Wakefield slightly north of east to the Murray Flats beyond Eudunda. From the Dalkey Range to the Hermitage Hill, the beds vary much in strike and dip and one bed is distinctly inverted. One mile east of Rhynie the faulted beds dip north-westerly, and the line of strike is only 25° from that of the section. The table-lands range is crossed at about 15° less than a right angle. All the other portions of the section are in the direction of the true dip or at right angles to the line of strike.—J. J. E.

Digitized by Google

Plants Collected in Central Australia,

Between lat. 22° 30′ and 28° S., and long. 136° 30′ and 139° 30′ E., by Ch. Winnecke, Esq., during his expedition in 1883; examined by Baron Ferd. von Mueller, K.C.M.G., M.D., Ph.D., F.R.S.

[*The following list was published in Mr. Winnecke's official report, but has received corrections from the author, and was ordered to be printed in the Transactions, by the Council of the Royal Society, December* 14, 1884:—]

Lepidium papillosum, *F. v. M.*
Erysimum Blennodia, *F. v. M.*
Capparis Mitchelli, *Lindley.*
Capparis lasiantha, *R. Brown.*
Drosera Indica, *Linné.*
Owenia acidula, *F. v. M.*
Bergia perennis, *F. v. M.*
Tribulus hystrix, *R. Brown.*
Zygophyllum Howittii, *F. v. M.* Petals about one-eighth inch long; filaments without appendages; anthers, when fully opened, almost roundish; radicle often three times as long as the cotyledons.
Erodium cygnorum, *Nees.*
Gossypium Australe, *F. v. M.*
Lavatera plebeja, *Sims.*
Abutilon leucopetalum, *F. v. M.* A variety with yellow petals of nearly two inches in length; some of the stamens fully as long; upper part of the styles exserted; fruit not seen. This plant offers an approach to A. exonemum, *Mons. Thozet*, sent from Muellersville, specimens with flowers fully three inches long.
Melhania incana, *Heyne.*
Seringea integrifolia, *F. v. M.*
Triumfetta Winneckeana, *F. v. M.* Leaves roundish or verging into an oval form, denticulated and somewhat crisp at the margin, velvety on both sides; sepals narrow, dorsally terminated by a minute conical appendage, petals downy towards the base; stamens numerous; ovary three-celled; fruit large, on slender stalklet, almost globular, indehiscent, thinly tomentose, copiously beset with long spreading bristle-like, nearly glabrous at the summit, hooked prickles. The nearest affinity of this plant is with T. leptacantha, but the fruits are much larger, and not glabrous; indeed,

Digitized by Google

they are in size similar to those of T. procumbens, but provided with longer and much more slender prickles. Leaves and flowers have been described from mere remnants adhering to the fruit.

Frankenia laevis, *Linné.*

Claytonia Balonnensis, *F. v. M.*

Atriplex leptocarpum, *F. v. M.*

Atriplex Muelleri, *Bentham*, var. lobaticarpa; dwarf, procumbent or ascendent, leaves small; fruit-bearing calyces minute, to the middle bivalved, digitate or flabellate, rhomboid, anteriorly cleft into five deltoid-semilameolar lobules, the lateral of which divergent or recurved, but often abbreviated, the lower portion of the fruit-calyx thickened towards the middle, but not appendiculated. This may possibly require specific separation, but the degree of variability of the group of saltbushes to which this plant belongs needs yet further to be studied in the field or from augmented museum material. The plant here under consideration reminds us also of A. fissivalve, from which it differs in less succulency, smaller leaves, less transparent, and less deeply valvate fruit-calyces, with shorter lobules without dorsal appendages.

Kochia triptera, *Bentham.*

Salsola kali, *Linné.* A variety of flowers and fruits crowded headlike on abbreviated branches; appendages of calyx minute.

Ptilotus latifolius, *R. Brown.*

Ptilotus alopecuroideus, *F. v. M.*

Ptilotus obovatus, *F. v. M.*

Polygonum plebejum, *R. Brown.*

Rumex crystallinus, *Lange.* Some of the plants only one inch high, though fully in fruit.

Macgregoria racemigera, *F. v. M.*

Isotropis Winneckei, *F. v. M.*, in Melb. Chemistry, Febr., 1884. An entirely new plant.

Crotalaria dissitiflora, *Bentham.*

Psoralea patens, *Lindley.*

Indigofera viscosa, *Lamarck.*

Swainsona laxa, *R. Brown.* A variety with somewhat larger flowers; lobes of the calyx considerably shorter than the tube, the two upper rather blunt; lateral petals dark violet-coloured towards the summit; stipe of pod slightly longer than the calyx.

Glycine sericea, *Bentham.* Reminds of Galactia tenuiflora.

Petalostylis labicheoides, *R. Brown.*

Bauhinia Leichardtii, *F. v M.*, var. cinerascens. In this singular variety the rust-coloured silky vestiture of the

Digitized by Google

calyces and petals is replaced by a thin dull-greyish tomentum. The same form has been obtained on Julia Creek, a tributary of the Flinders River, by Mr. Armit; there particularly the petals become glabrescent. The leaflets are narrower than usual. Fruit for further comparison is not available. The far extratropic Bauhinia of Cooper's Creek is B. Carronii.

Neptunia gracilis, *Bentham.*

Acacia dictyophleba, *F. v. M.* Young pod broad linear, viscid, straight, flat, not hairy, somewhat thickened at the margin; stipe short.

Calycothrix longiflora, *F. v. M.* This has recently been also collected within the limits of New South Wales, near the Warrego, by Mr. Betche.

Melaleuca glomerata, *F. v. M.* Flowers small; tube of calyx thin-velvety, lobes short and blunt; petals tender-membranous, almost colourless, ciliolated, otherwise glabrous; stamens, when dry, pale yellowish, five to seven in each bundle; the connate portion about as long as the petals, but much shorter than the free portions of the filaments.

Eucalyptus gamophylla, *F. v. M.* On the specimens now collected the upper leaves become narrow lanceolar, continuing opposite or getting scattered.

Eucalyptus microtheca, *F. v. M.*

Lythrum hyssopifolium, *Linné.*

Ammannia multiflora, *Roxburgh.*

Haloragis Gossei, *F. v. M.*

Didiscus glaucifolius, *F. v. M.*

Pimelea simplex, *F. v. M.*

Loranthus Quandang, *Lindley.*

Melothria Maderaspatana, *Cogniaux.*

Pomax umbellata, *Solander.*

Oldenlandia tillæacea, *F. v. M.*

Dentella repens, *Forster.*

Calotis cymbacantha, *F. v. M.*

Calotis lappulacea, *Bentham.*

Vittadinia Australis, *Richard.* Fruit specimens only two inches high.

Pterigeron adscendens, *Bentham.* A dwarf form, with larger ligules of the ray-florets.

Epaltes Australis, *Lessing.*

Myriocephalus Rudallii, *F. v. M.*

Myriocephalus Stuartii, *Bentham.*

Helipterum floribundum, *Candolle.*

Gnaphalium luteo-album, *Linné.*

Senecio Gregorii, *F. v. M.*

Wahlenbergia gracilis, *A. de Candolle.*

Digitized by Google

Isotoma petræa, *F. v. M.*
Brunonia Australis, *Smith.*
Erythræa Australis, *R. Brown.*
Duboisia Hopwoodii, *F. v. M.*
Solanum oligacanthum, *F. v. M.*
Nicotiana suaveolens, *Lehmann.* The flowers in some of the specimens less than an inch long.
Stemodia Morgania, *F. v. M.*
Justicia procumbens, *Linné.*
Ipomœa Muelleri, *Bentham.*
Cynanchum floribundum, *R. Brown.*
Pollichia Zeilanica, *F. v. M.*
Halgania cyanea, *Lindley.*
Heliotropium filaginoides, *Bentham.*
Teucrium racemosum, *R. Brown.*
Clerodendrum floribundum, *R. Brown.*
Newcastlia spodiotricha, *F. v. M.* Found also by Mr. Kayser at Eyre's Creek; by Mr. Giles, near the Alfred and Mary Range; and lately near Mount Everard. Corolla deep blue.
Dicrastylis Dorani, *F. v. M.*, var. eriantha; leaves narrower, conspicuously tomentose; glomerules of flowers two or more superposed along the stalks; calyces involved in a dense woolly vestiture; corolla as in the normal form, almost bell-shaped, its tube short and turgid, the lobes obtuse. The Rev. H. Kemp sent a small-leaved variety from the Finke River.
Dicrastylis Lewellini, *F. v. M.* Tube of the corolla cylindrical, longer than the rather acute lobes; the fifth stamen between the two smaller corolla-lobes often altogether wanting, but sometimes developed and quite perfect. This and other rare plants brought by Mr. Winnecke extend probably along sandy tracts of country into Queensland territory.
Eremophila Macdonnellii, *F. v. M.*
Eremophila Willsii, *F. v. M.* A variety with branches and leaves glabrous.
Eragrostis speciosa, *Steudel.* Fully in flower at less than six inches in height.
Aristida stipoides, *R. Brown.*

Digitized by Google

Remarks on some Indigenous Shrubs of South Australia suitable for Cultivation as Fodder.

By Samuel Dixon.

[Read February 5, 1885.]

In considering some of the fodder plants of South Australia, instead of drawing your attention to the herbs and grasses, which are popularly looked upon as comprising our only stock foods, I am desirous of making some practical remarks upon a number of plants, usually shrubs or small trees, which constitute a most important part of the food of sheep and cattle, especially in the drier and more arid portions of this colony, some of which are to be found widely spread through northern districts, and extending to our eastern and western boundaries. The subject cannot be exhausted in one evening, but I feel that in view of its great importance to the well-being of the colony I may by bringing it under the notice of the Royal Society of South Australia assist in spreading a knowledge of the advantages of preserving, cultivating, and increasing the growth of a class of stock food which suffers but slightly from droughts, and which by its abundance adds greatly to the numbers of stock depasturing in certain areas, and by providing a constant supply of wholesome food promotes the growth and quality of that wool which is our chief export; and finally, adds so much flavour and sweetness to our mutton. It seems very desirable that many of these plants should be extensively cultivated, as their foliage becomes available when the grass is either gone or has lost all its nutritious qualities. In the large estates used solely as sheep-walks, lying mostly to the north of Adelaide, if belts of these native shrubs were laid out and the sheep only admitted during the months of April, May, June, and July, I am convinced the condition of the sheep would be better maintained, and consequently the growth of wool sounder and more abundant; the percentage of lambs would be higher, and in the long run more stock would be carried on the same area.

The study of shrubs edible for stock is one of the very greatest practical importance not only to the sheep farmer, but to all dependent on him in business; the presence or absence of certain of them renders the occupation of large tracts of country profitable or the reverse, and an adequate knowledge of them is of the first importance. At present very few of

Digitized by Google

those whose interests are bound up with stock can either name correctly or accurately describe the plants on which they indirectly subsist, although everywhere in Australia amongst practical men certain prevalent forms of vegetation give a name to well-understood sorts of country; for besides the general distinction of grass country or saltbush country we have in each of the colonies familiar expressions roughly denoting the healthiness or otherwise of certain areas, such as the "jam" country of West Australia, named from an acacia whose wood is scented like raspberry jam; or again, in New South Wales, another acacia, the "myall," with violet-scented wood, is a certain sign of the healthiness of certain districts; or in our own colony, "mulga" country defines certain peculiarities of soil and climate.

Very heavy losses have arisen from sheep farmers being misled as to the food qualities of the scrubby vegetation. For instance, many of the scrubby plants of the Murray Scrub are excellent fodder; others, characteristic of the South-East and Kangaroo Island, are so deficient in nutriment that sheep can barely exist, as they are mainly Hakeas, Grevilleas, Melaleucas, Banksias, &c., whereas the shrubs to which your attention is to be directed greatly assist in producing that excess of stearine in tallow which is the main cause of stock retaining their fat during long journeys, and this excess of stearine is conspicuous in cattle fattened amidst the saltbush and mulga of the North. But, on the contrary, the deficiency of stearine in stock fattened in the South-East is the reason why they "waste," or in other words, lose condition so much before reaching the Adelaide market.

It is the more desirable to consider this subject, because I fear that in some localities many of the most valuable of our shrubs are doomed to extinction from the fondness of stock for them and from that system of overstocking which too commonly prevails, and because in some localities—as, for instance, from the east bank of the Murray River to the Victoria border—the rabbits are barking and completely destroying all those shrubs which gave that region its chief value as a grazing country; and as the seasons when sufficient rains fall to give a good growth of grass are very irregular and uncertain, a vast area is likely to become more or less a real desert.

It is also noteworthy that stock do NOT in different localities invariably eat the same plants; of this, the Native or Cypress Pine (*Callitris verrucosa*) is a striking instance. On the Murray and in the North it is greedily eaten wherever stock can reach it, but on the western slopes of the dividing range in New South Wales and to the south-east of Cobar, the same tree becomes a real pest to stockholders, for, seeding very abundantly,

Digitized by Google

a dense growth of young pines prevents grass from growing; and there is not grass enough to carry fires through the country, as was the case before the country was stocked, and the result is that land there is now much less profitable to occupy.

The leading characteristics of our vegetation are peculiarly adapted to the arid zone it occupies, and which for fodder plants capable of withstanding protracted droughts is, I suppose, the richest in the world. Compared with South Africa, I can personally testify to its great superiority; and in the corresponding zone in North America the census of fodder plants is also much smaller, while in South America the cactus family (few of which are edible) too largely prevails.

To conclude these preliminary remarks, permit me to acknowledge very gratefully the kind assistance of Prof. Tate in lending specimens and in furnishing me with the scientific names necessary to identify plants, many of which, so far, have no common name, but where one exists I gladly use it; and finally, my only title to address members of this Society arises from a close practical observation continued for many years over large areas of this and the adjoining colonies.

I propose to mention first those plants which are common around Adelaide and in our moister climates, and afterwards to describe those belonging to more arid regions, but which are well worthy of cultivation wherever they will grow.

Bursaria spinosa.—A very common bush, named from the supposed likeness of its heart-shaped seed vessels to the pods of Shepherds' Purse, and from a few thorny spines much better deserves its second name. The flowers are small and white, in large pinnacles, and most abundant during summer. In the South-East it grows to be a small tree with larger leaves (and without spines) than is ever found this side of the Murray. Sheep eat it as soon as the grasses dry up, and where abundant makes a good "stand-by," and is of great value in late seasons. Its spines prevent its being eaten out like the last described. It stands pruning well, and would be serviceable as an ornamental hedge to cottage gardens.

Pomaderris racemosa.—This is another common bush in the moister districts, and seldom exceeds two feet in height, with an abundant foliage of smallish roundish leaves. The flowers are inconspicuous in small clusters, and the leaves when chewed or soaked are found to be slightly mucilaginous; this explains the fondness sheep have for this plant. It always seems fresh and green, and stands stocking well.

Pittosporum phyllæroides.—A small tree, with whitish bark, and drooping foliage of narrow leaves; flowers small and

Digitized by Google

d vessel before opening is oval, and of a bright
r, highly resinous, and its flavour is most disagree-
eep are exceedingly partial to its foliage, and when
in pulling down a branch the rest make a rush to
ich a dainty, and owing to this the tree itself is
terminated, although originally very common in the
f Port Lincoln and the Murray. Were this culti-
eep only admitted occasionally to the enclosures,
er reach a troublesome height. Like most of its
easily raised from seed.

quadrivalvis.—The Sheaoak so common around Ade-
tock devour this tree, and in Port Lincoln the
s (male infloresence) form the chief sustenance in
ich of the overstocked country. In many parts
f fenced off, is quickly covered with the young
after the third year the sheep were admitted only
inter they would be prevented from growing too
oo sour to be very useful to ewes rearing lambs,
nly had enough of it, the "brake," or tenderness
d often be prevented in our finer wool districts,
ney saved by the increased value a sound staple
ands.

The Wattles of various sorts are common almost
The common or Golden Wattle, *A. pycnantha*, is
xtensively cultivated for its bark; for grazing,
value is not so well recognised, but I am of opinion
r its value as an astringent is very great, as sheep
from a diahorrea caused by eating frozen grass, and
provided to any of the varieties of Wattle this
, and the improved clip will repay the wool-
xtra trouble of cultivating this ornamental and
e.

lanoxylon. — The Blackwood, which is confined
the South-East and our cooler southern valleys,
use for its timber (which is one of the hand-
ture woods in Australia), than for its foliage,
gh eaten by cattle and sheep, is not of the greatest
e contrary is the case with the mulga, *Acacia aneura*,
e of the very greatest importance in Central Aus-
it covers large areas, sub-varieties of which there
ng somewhat difficult to define, varying a little
the locality. The stony ranges, the rich red loamy
ne sandhill country have each a mulga differing
size of the leaves and position of the branches,
ed by the aborigines under distinctive names, the
ga having numerous branches at nearly right

Digitized by Google

angles to the main stem. The narrow leaves are comparatively veinless—hence its specific name—and the flowers growing singly are of oblong shape, instead of spherical, like *A. pycnantha*. Its most remarkable characteristic, however, is the mucilaginous quality of its foliage, a leaf, when chewed, yielding a distinct flavour of gum, and without that astringent taste so common in Acacias grown in the moister regions. The presence of mulga in sufficient quantities is of the first importance in runs situated in the more arid portions of Australia as being not only the best stand-by, but as furnishing posts for fencing, the timber being very close-grained, hard, and lasting. As to how long the timber (generally of small size) will remain in the ground without decaying it is very difficult even to guess at, for it frequently happens that old forests of it are found standing evidently killed by fire, amidst a growth of young trees, which must have taken many years to grow to their present size, for the mulga is a very slow grower, but if cultivated in a moister climate I think would grow more rapidly, and yield a less scanty foliage. Amongst stockmen it has an evil reputation, as wounds caused by riding through scrubs of it often fester, and are difficult to heal. The most southern limit of it that I am aware of is at Anabama, some 90 miles from the Burra, on what is well known as the Pegline, the surveyed road to the Darling. It has been used extensively for smelting at Cobar, and exists around Silverton, and no doubt its close-grained charcoal will be very useful in reducing the silver ores there.

With the view of getting precise and reliable information as to the properties of the scrub in question, a sample of it was forwarded to Mr. William Johnson, the analytical chemist for the Victorian Government, who further submitted it to Baron von Mueller, the Victorian Government botanist, and it affords me considerable satisfaction to give you an extract from the report of Mr. Johnson as to the value of mulga: — "Examined chemically, it has been found to contain a large quantity of starch and gum, together with albuminous bodies and other constituents common to all vegetables. It is destitute of any poisonous properties, and, viewed as an article of food, must be very nutritious to all animals eating it. The mineral constituents amount to two per cent., and consist of carbonates of lime and potash, together with sulphates and chlorides, all very useful in the animal economy." Baron von Mueller's report is purely confirmatory of the above, and need not be repeated.

Acacia salicina—The Broughton Willow, as it is called in the North, being found mainly on the River Broughton and its tributaries. A very handsome little tree with drooping

Digitized by Google

branches; a good deal eaten by sheep and cattle. It resembles some of the drooping myalls of New South Wales; its seed-pods long and narrow, each seed being surrounded by a velvet-like thread or aril of a deep red orange colour; like most of the family, its seeds germinate more surely and quickly by being soaked in boiling hot water. The procession caterpillar destroys many trees by eating off the foliage, and the singular silk bag filled with the exuviæ of this destructive insect are to be found hanging in large numbers on the trees. *A. Oswaldi*, found on the Murray, is much less handsome, but is also eaten by stock.

Cassia eremophila.—A pretty little shrub with three small leaflets on each side the leafstalk, flowering abundantly in the Spring; the flowers bright yellow, scented, and nearly half an inch across; easily propagated, and both pods and leaves eaten by sheep; is widely spread in dry regions.

Cassia phyllodinea.—This species is named from its leaves being merely flattened phyllodes, and these are bifid at the extremity. This is inedible, excepting the pods when green, and is a nuisance in spreading over the warm loamy soil of the Lower Darling and similar country here; but, unlike the foregoing, grass will not grow beneath it, and is mentioned to prevent its being grown in error.

Cassia artemisioides.—This is one of the handsomest of the tribe, and is worthy of being cultivated for its very showy yellow blossoms.

Templetonia retusa.—Another showy leguminous plant, which is not uncommon on limestone soils near the sea, but grows very freely on deep, rich, red soils. Its large red pea flowers are abundantly produced, and sheep devour the green pods and the leaves also; it is easily raised from seed, and not growing too high, and the branches being close and the foliage abundant, would be useful also as a "breakwind" on exposed plains. A very handsome dark-flowered variety is common on the Flinders Range. The specimen came from the Port Germein Pass.

Myoporum platycarpum.—The so-called Sandalwood of the Murray, and is common in dry limestone soil throughout the less humid parts of the colony. Its leaves seem to be eagerly eaten by sheep when they can reach them; but the tree generally grows from 20 to 30 feet high, and is often felled for sheep when long droughts prevail. If the branches are lopped off the tree soon starts a fresh growth, and by the time another drought comes has often a sufficient growth to again bear lopping. It is often wantonly destroyed, and should be protected by regulation. It is a very elegant tree, having quan-

Digitized by Google

tities of small white blossoms in January or February, and is well worth growing as a "stand-by." Had the City Gardener planted this tree in the North Adelaide Park Lands, on the limestone soil, the result would have proved much better than planting red gum, elms, &c., which can only have a miserable existence before they finally die off. The timber has a pleasant scent when burned, but if used as posts, is liable to be eaten and destroyed by beetles.

Santalum acuminatum.—The Quondong, or Native Peach, belongs to the real Sandalwoods, and is one of those shrubs which soon disappears with heavy stocking. Cattle breaking it down, and sheep eating off the shoots soon kill the trees, and young ones are very few and far between ; in fact, from my observation, I believe that to be swallowed by the emu is almost necessary for the germination of its well-known seed. I can hardly recommend it for general purposes as a fodder plant to be cultivated, for, although its foliage is very nutritious, the plant seems too tender except in rich moist nooks. Its very light green leaves have a yellowish tint, which in shrubberies would form a good contrast, and when covered with fruit of the brilliant shiny crimson so well known to bushmen is a very striking object in the dull green usually around.

Eremophila longifolia.—The Dogwood of bushmen, and named by them from the offensive smell which the leaves have when crushed. The tree itself is not uncommon, and may be known by its woody seed vessel, covered by a black shiny skin; by its dull red blossoms, nearly two inches long; and drooping leaves three to four feet long. It likes deep rich soil. Sheep are exceedingly fond of its foliage, and they are apt to eat even the twigs, so that when grown it is necessary sheep should only have occasional access to it. It is one of the first to be barked by rabbits. Another species, *E. Brownii*, has a bright scarlet-coloured flower, but the foliage is too scanty to render the plant worth attention. It was common on the hard limestones of Port Lincoln, but is now much scarcer there.

Geijera parvifolia.—The Sheep Bush. Sheep only are particularly fond of this bush, which grows on hard limestone soils, and seems quite unaffected by droughts. It seldom grows more than ten feet high, and has a number of small stems from the crown of the roots. You will always find every leaf eaten off within reach of sheep, who eat it at all seasons. The seed vessel always contains two small shiny black seeds, ripening at the end of summer. The dense growth of this shrub gives a good deal of shelter, and in its native state affords the kangaroo shelter from the sun. I should like to see this shrub established on all sheep farms. The specimen came from Telowie. It ought never to be destroyed wantonly.

Digitized by Google

Nephelium oleæfolium (v. Mueller).—*Heterodendron oleæfolium* (p. 124, "Native Plants of Victoria").—This small tree is also common, and the bitter taste of its dull grey leaves resembles quinine. Both sheep and cattle feed very greedily on this little tree, but as soon as stock are removed from the paddocks it is one of the first to recover, throwing out fresh leaves, and like the last described is of very great value in dry seasons. I have seen it as far south as the Government Farm, Roseworthy, but in the Bourke district of New South Wales are the largest specimens I have seen, the rich, warm, loamy soil seeming to suit it exceptionally well; the increased size and dense foliage giving a welcome shelter from the sun. Judging, too, from the bitter flavour it is likely to be of use in medicine, and I hope some of your learned members of the medical profession may be induced to experiment with it. It cannot be too frequently grown.

Leptomeria aphylla.—This stiff, awkward-looking shrub is well described as *aphylla*, only the very youngest shoots showing traces of anything like leaves; in fact, the shrub resembles a parcel of green sticks and small stiff twigs. It is by no means ornamental, and its small red fruits, with a little green knob at the end, are too inconspicuous to attract attention. Sheep, however, find it pleasant to browse on, and in doing so often fill the wool on the top of the neck with its small twigs. I can hardly recommend the cultivation of this queer-looking shrub, but it should never be destroyed where it grows naturally.

Exocarpos cupressiformis. (The Native Cherry).—This very handsome tree is a favourite food with sheep and cattle, and a young tree is consequently somewhat uncommon. If it can be readily grown, however, there is no doubt of its desirability, but as it likes rich soil and a cool climate, I do not expect it will be used as a fodder-plant generally.

Gossypium Sturtii.—This very showy summer-flowering shrub, named after the gallant explorer, Colonel Sturt, is a native of the glens of the mountain ranges of the interior. It grows very freely in gardens around Adelaide, is very easily propagated, and affords stock a good summer feed; and is as handsome in pleasure grounds as it is useful as a sheep and cattle food. It is a suitable plant for gardeners to cultivate, and likes a fairly rich soil, and when cut down (if not too close to the ground) sends out plenty of young shoots. Its absence from the city Park Lands is a good specimen of their general mismanagement, and how little native shrubs are appreciated.

Sida petrophila.—This showy little plant is well named *petrophila*, or rock-loving, being most common on the top of all northern ranges in the saltbush country. The disc-like yellow

Digitized by Google

blossoms and downy grey-green leaves render it very conspicuous, although it does not much exceed three feet high, and, like other plants affecting the same situations, flowering after copious rains. There should be no difficulty in growing it commonly, but it does not like too moist a situation. It seems to be as much liked by sheep as by marsupials, and I have seen large tracts quite cleared by their united efforts.

Dodonæa viscosa.—The native Hop Bush, and one of the largest of the Dodoneas growing here. Its chief use as a fodder plant is in the "hops," as bushmen call the four, round, winged seed vessel, each section of which contains a little black seed. It produces large quantities of seeds, and during November and December, until its coppery-red seed vessels get too dry, sheep and cattle eat them eagerly. The foliage is resinous, and to see the bush eaten down is a sure sign of "hard times" with the sheep. It is sometimes twelve feet high or more, and likes warm, red, sandy ground. In the old times when shepherds were kept to look after sheep, the hutkeepers used the "hops" as a substitute for the real hop in making sugar-beer and to make yeast for bread. It is very suitable for cultivation in shrubberies.

Lycium australe.—This is a very useful fodder plant indeed. It grows up to four feet in height, and is thickly covered with short oblong juicy leaves. Drought never seems to affect it, and having many spiny points, sheep can never quite eat it out. It is also one of the very few shrubs in saltbush country which throw out abundant suckers. The flower is small, lilac-white, and salvia-shaped; the fruit is also small, bright red, and of a sweetish tomato flavour. The shrub is abundant nearly everywhere, and is often recklessly destroyed by farmers in their attempts to grow wheat in unsuitable places. I believe it to be very fattening, and likes saline soils.

Zygophyllum fruticulosum.—This small shrub is very common in calcareous soils and sandhills. It has small juicy linear leaflets in pairs. The seed vessels resemble in shape and size the *Dodonæa* above described. It has an abundance of single yellow flowers, and on Yorke's Peninsula, around Wallaroo, it grows very plentifully on long fallowed ground. It is also common among the mallee scrubs, and sheep, feeding where it is common, care less for water, finding abundance of moisture in its singular leaves. From a letter of Baron Sir F. v. Mueller to Prof. R. Tate it appears that the *Zygophyllum* family is poisonous in South Africa, and certainly I have had reason to suspect *Z. glaucesens* of killing sheep, but have never had the opportunity of testing it. I am, however, very confident that *Z. fruticulosum* is not injurious, for although not universally and at all

Digitized by Google

seasons eaten by sheep, it is quite eaten out in the Murray River scrubs, and I never knew any ill-effects produced by it. The other *Zygophyllums* are seldom or never eaten by sheep.

. *Goodia medicaginea.*—This handsome shrub will grow to four or five feet high, or even higher, and retains its foliage throughout the year, having a preference for limestone soils, and flowers during September and October; produces an abundance of seeds in short pods. Horses, cattle, and sheep devour it greedily, but of late years I have seldom seen it. The specimen was gathered near the Duck Ponds, Port Lincoln, inside a fenced-off piece of road, otherwise, no doubt, it too would have disappeared by being eaten out. Some allied species are poisonous, but I have never known injurious results from eating this one. Baron von Mueller, in the letter above-mentioned, also states that, in Gippsland, *Goodia latifolia* has been proved to have poisoned cattle. It would be interesting to know for certain whether the poison exists in the seeds or leaves. It often happens that a good deal of obscurity exists about poisonous plants and their effects, as they seem very uncertain. A friend of mine lately fed some old ewes on the undoubtedly poisonous *Euphorbia Drummondi*, but could not kill them, although he often loses an odd sheep or two from poison, and no other known poisonous plant exists on his property. I am inclined to believe that many leguminous plants reputed to be poisonous are not really so, but that an excess of either foliage or seeds eaten by a hungry animal throws off such an abundance of gases that "hoove," which is nothing more than an excessive distension of the stomach pressing against the diaphragm, preventing the lungs from working, and the animal is really strangled to death. To this cause I attribute all the deaths (and they are very numerous) caused by *Lotus australis var. Behrii;* really an excellent fodder plant, akin to the lucernes, but when seeding, and especially after rain, if hungry sheep are allowed to feed greedily upon it they die by hundreds, while sheep in confinement and fed solely on it do not die but actually thrive, as was proved some years since in Adelaide.

Kochia aphylla.—The Cotton Bush, so well-known and of such vast importance to herds and flocks in all our dry and very arid country. It belongs to the real saltbush order, and not like the two last described, which are only popularly considered so. It derives its popular name from the white cotton-like balls, the effects of a gall insect, very conspicuous indeed on a plant which so well deserves its scientific name of *aphylla* (without leaves), or sometimes present as mere scales. The plant usually presents the appearance of a round heap of reticulated green wiry twigs. It is most common on red clays and loams, espe-

Digitized by Google

cially where liable to occasional floods, and in the immense plains of the interior is a most reliable sign of those watercourses which, as they only become such at very long intervals, could hardly be traced but for this singular plant. Petals it has not, but the calyx is five-lobed, with a broad horizontal connate membrane. All kinds of stock are often largely dependent on it during protracted droughts, and when neither grass nor hay are obtainable I have known the whole bush chopped up and mixed with a little corn, when it proved an excellent fodder for horses. One drawback it has: its stems being very fibrous, and the older portions indigestibly so, it is the principal cause of those bezoars or felted knobs in the maniplus of the sheep, which in very protracted droughts kill them by hundreds. When, however, the rains come, and soft herbage is abundant, these bezoars either partially dissolve or become covered with a shiny-black coating, so that they then resemble a "papier-mache" ball. I believe the Cotton Bush attains a great age, and have often observed the extreme distance its fibrous roots spread. This is another of those plants which should never be ploughed up. As far as I have observed it does not commonly grow again, and has a greater value in its native habitat than anything which can permanently be grown there, and apparently does not seed freely.

Kochia sedifolia and *K. villosa*.—Commonly known as Blue Bushes. These grow on very healthy sound sheep country, but are not themselves good fodder plants. As a matter of fact, should they be eaten, the sheep must have suffered a good deal of starvation, and if they are eaten out, you may be certain sheep must have died in numbers. Before leaving *Kochia villosa*, it may be remarked that Baron von Mueller looks upon the Cotton Bush *(aphylla)* as merely a variety; but this is a case where we may look upon the sheep as a better botanist than ourselves, as both *K. villosa* and *sedifolia* seem to be very distasteful to them, and while we admit the exact similarity of the horny flower and fruit, I do think the extraordinary length of the roots of the Cotton Bush, as well as its difference in everything except the flowers and fruit, should entitle it to a distinct and separate position, and allowing this, I have observed two sorts growing near together mostly distinguished by the difference in the shade of their green stems, and in this case too sheep make a difference between them. Around Forbes, in New South Wales, I have seen another variety of *aphylla*; its young shoots drooped, were of a lighter green, and the small leaves or bracts more abundant.

Rhagodia parabolica.—This is another saltbush, which produces a good deal of foliage, and is not uncommon. Generally

Digitized by Google

found forming a low bush around some bigger tree; I have noticed it especially with *Leptomeria*. It is worth attention for cultivation. *R. spinescens*.—The same remarks apply to this species of saltbush also.

Chenopodium microphyllum.—A saltbush, like the preceding, often found protected by some larger shrub, and sheep care more for it than for many other saltbushes. It would be useful if growing freely; but experience must prove the best guide, as I think it possible some of the saltbushes will prove difficult to grow out of their own special localities.

Atriplex vesicaria.—This is one of the most common and widely-diffused of saltbushes, and is sometimes called the Small White Saltbush. This, I think, can readily be grown wherever the climate is not too wet. It covers very large extents of clayey plains, and in good seasons is only nibbled at by stock, excepting when covered by those curious vesicles which give name to the species. There is an annual sort much resembling it which unfortunately I have failed to determine the precise name, but the tops of the young plants are fairly edible when boiled, and together with *Tetragonia expansa*, or Native Spinach, have often afforded me a change of diet in the outside country. Before the vesicular seed vessels are quite ripe they make quite a loud report if trodden under foot.

Atriplex nummularium.—Often called the "Cabbage" Saltbush, from the comparatively large size of its leaves. It grows to over eight feet high, and is found commonly near to where water lies for some time; also on flats bordering the Murray that are rarely flooded. Eaten by sheep when food is scarce, not difficult to grow from seed, and adapted to form a contrast in shrubberies from having scaly grey leaves, and forms a dense bush.

Atriplex paludosum. — This saltbush is named from its favourite habitat, and may be readily distinguished from *A. vesicaria*, the leaves being much narrower and more erect. I mention it mainly to point out that not all the saltbushes are edible. This one in particular stock never eat if anything else is to be had.

Rhagodia Billardieri.—This small shrub is a very useful fodder plant, much eaten by sheep, although the branches are spinescent. It is mostly found on rich ground liable to floods, and is not very common here, although very abundant on the River Darling. From its habitat being restricted to flooded ground I do not think it worth cultivating. It should never be ploughed up, but, like all other of the best of the shrubs of which I have treated, it is imperative that sheep should not be kept constantly where it occurs.

Digitized by Google

Sarcostemma australe.—A very singular plant, named by Robt. Brown, the great botanist of Flinders' voyages, and described by him as a trailing twiner, but as found here it is a leafless mass of rigid stems three to four feet high, somewhat glaucose, scarcely so thick as a penholder. The stems, if broken, exude an acrid milky juice, but on the stony table-lands of the north-western district sheep have lived on this plant for months without water, and kept up their condition. The aborigines are also said to use it to prevent ulcerous sores from spreading. Like many more of the foregoing, injudicious stocking causes its complete destruction. In fact, all over Australia, wherever bushes of similar character to those described in this paper predominate, the extreme unwisdom of overstocking is most alarmingly evident, and each succeeding drought makes matters worse. The necessity felt by the sheep farmer to recoup heavy losses prevents his run being so lightly stocked as to permit of the young plants becoming established, with the result that each succeeding drought is more severely felt.

In concluding these remarks I hope some abler observer of plant life in the interior may publish notes, not only on our unsurpassed and exceedingly valuable grasses, which withstand drought in so remarkable a manner, but also on those very fattening herbs which cannot be surpassed in the whole world for their property of forming fat very rapidly, and of such a quality that stock travel enormous distances to market, and waste so slightly as to be able to surpass stock fattened locally. One such herb is that deliciously-scented clover, *Trigonella suavissima*, or Menindie Clover, which grows on soils subjected to lengthened inundations, such as Menindie Lake, and another is that useful vegetable *Tetragonia expansa*, or Native Spinach, very often boiled when garden-grown vegetables are scarce, and very many others, some of which may become of great use when cultivated beyond their natural limits.

It is very much to be desired that some one may also point out those plants, natives of the heated interior, which are likely to grow in the settled districts during summer, as I think it may be possible to sow with the seed-wheat annual grasses or succulent herbs which would grow during the hot weather, and after the grain is reaped. The immense advantage this would afford needs no enlarging upon; it would double the stock-feeding capacities of our farms, and I hope experiments in this direction by the able Professor of Agriculture at Roseworthy may be undertaken, as promising results of the greatest practical importance to all districts of the colony.

Boerhaavia diffusa.—In *Boerhaavia diffusa* we have one such plant—a perennial of straggling habit, with juicy leaves, often

Digitized by Google

lanceolar in shape, and when fading the underside has a characteristic pink hue. The Field Naturalists' Section found it near Noarlunga last summer. All sorts of stock feed upon it, and its trailing stems are found on many of the sandhills in central regions.

Claytonia Balonnensis.—This showy plant, called "Munyeroo" by the aboriginals, derives its secondary scientific name from the Balonne River, Queensland. It has a cluster of thick fleshy leaves, with a flower stem some six or more inches high, crowned with bright deep pink flowers as large as a shilling. Half an inch of rain, and it rapidly covers the sandhills. Cattle then leave the waters and feed on it, going without a drink for weeks together, and recently a large mob of cattle, destined to stock a Northern Territory run, travelled some 200 miles without a drink—a truly wonderful journey—and without this succulent herb altogether impossible. It is highly esteemed by bushmen and aborigines, and eaten either raw or cooked. Many others of the Central Australian vegetation are very interesting, and will repay a careful study, and some may possibly prove adapted for cultivation. One succulent plant, *Portulaca oleracea*, common to Europe, Asia, and Australia, may be found as a weed in our gardens, and is a useful sheep food in central regions, where its rounded, fleshy, jointed stems trailing close to the sand seem to luxuriate in heat, and to find the scantiest rain sufficient to give it vigorous growth.

In closing these very sketchy remarks, it may be hoped that as a knowledge of our native vegetation spreads, much advantage will result to the colony; for if our indigenous fodder plants are preserved, instead of being recklessly and wantonly destroyed, more good will result than by afterwards endeavouring to introduce new plants from similar climates, although in this direction also there is an immense field open of the most promising description, but as far as experiments have yet gone nothing exceeds, in practical use, our own native flora.

Digitized by Google

Notes on Iridescent Clouds.

By W. A. Jones.

[Read May 5, 1885.]

In some of the scientific journals attention has been lately drawn to the phenomenon of iridescence in clouds in daytime. The mass of correspondence on the subject may be assumed to have been started by the great amount of interest lately excited all over the world by the beautiful sunrises and sunsets, with the accompanying theories which have been propounded to account for them.

There has thus been a large amount of contemporaneous observation lately directed towards all meteorological peculiarities. Many of the observers have seen things new to them, and have recorded their observations as original, whilst in some cases the appearances observed have been misnamed, and the term "iridescent clouds" has been frequently applied to tints belonging to an entirely different class of sky colours.

I shall endeavour to show by evidence that the appearances which some observers have referred to unusual conditions are not new or unusual, but that they have been observed a long time past, and are of frequent occurrence, though they often escape detection.

It will be seen from the descriptions by others and myself that the clouds under notice are similar to those observed by Herschel in 1841, and described in his meteorology. I shall quote Herschel first. He says:—"The clouds were tinged with bands of colour, not in circular form around the sun, but following the sinuosities of the clouds. The colours commenced from the white area forming the interior, and proceeding outwards to the edge, were—1st, white; 2nd, very pale pink; 3rd, blue green; 4th, at the edge, purplish pink. These colours obviously had no reference to the greater or less proximity of the clouds to the sun, but depended upon the thickness of the cloud or the length of the path within it traversed by the visible rays. After watching for some time the bands grew broader and the tints stronger, with a tendency to form a corona. It seems impossible to regard these colours otherwise than as the resultants of the superposition of a series of interference fringes following a regular progression of breadth (due to a progressively increasing size of the drops) from the exterior to the interior of the clouds."

Similar clouds to these were observed and recorded at the

Digitized by Google

University Observatory, Christiania, in 1871, February 22nd, March 1st, May 10th; 1874, January 13th; 1875, February 17th; 1882, January 11th, February 22nd, July 13th; 1884, December 8th, 9th, 10th, and 12th.

The following is an extract from the observations of Christiania, January 11, 1882:—"At 3.30 p.m., sun having set at 3.20, extremely beautiful cirro-stratus iridescent clouds in south-west, at an altitude of 8° to 12° were seen. The upper borders, and later on the lower borders, were red, with yellow brims, the red of the borders and the inner parts were variegated, and very variable, resembling the red light commonly seen in mother-of-pearl. This changed through crimson into blue-green, and then into grass-green. The most striking cases of the phenomenon have been observed here when mild and dry weather set in after frost."

The extracts from my own notes also show that these clouds occur frequently. Thus:—

"In 1884, June 12, D.B., 78°; W.B., 67°; iridescent* clouds, and fine glow.

"June 15, D.B., 83°; W.B., 56°; iridescent clouds, beautifully tinted.

"In 1885, January 16, D.B., 80°; W.B., 61°; edges of clouds tinted pink, with green farther in. The red extended beyond the edge, like the red glow seen above the horizon; clouds of a heavy cumulus kind.

"January 26, D.B., 70°; W.B., 58°; iridescent clouds, very fine, all being high cirro-cumulus.

"January 28, D.B., 71°; W.B., 55°; barometer falling, very short glow in morning, faint clouds, and an ice-cloud halo visible nearly all day; the green very bright; clouds were very high cirro-films. Iridescent clouds seen about 10 a.m., just before halo formed.

"January 30, D.B., 80°; W.B., 60°; iridescent clouds like Herschel's present. The light appeared to be polarised in planes tangential to the sun; colours very varied. A fine pink halo existed round the sun.

"February 21st, D.B., 71°; W.B., 62°; clouds rather high, clearing off towards noon; beautiful pink halo round sun; iridescent clouds appeared; fine glow, and afterglow in the evening.

"March 9th, D.B., 71°; W.B., 58°; iridescent clouds of filmy character, halo very pink; splendid afterglow in evening; not very fine in the morning.

"March 10th, D.B., 75°; W.B., 61°; barometer falling, tem-

*In my original notes I described these clouds as Herschel's clouds but have here termed them iridescent clouds for the sake of uniformity.—W.A.J.

Digitized by Google

perature falling; splendid pre-glow, and glow in morning; peculiar streaky clouds coming up. Iridescent clouds at noon. Remarkable sun appearances at sunset—(see description in report of the Mathematical Society, Port Adelaide, 1885).

"April 17, D.B.,59°; W.B., 54°; max. temp., 65°; min. temp., 48°; m. bar., 30·46; very fine pre-glow and delicate change in colour of clouds, some being of transcendent beauty; filmy clouds formed, and became iridescent. Halo changed from pink to ice-halo. No glow in evening.

"April 22nd, D.B., 67°; W.B., 55°; max. temp., 75°; min., 52°; m. bar., 30·24; iridescent clouds; rather high clouds.

"April 30th, D.B., 66°; W.B., 52°; max. temp., 76°; min., 50°; m. bar., 30·32; cirrus clouds, rather heavy; beautifully iridescent at various times.

"May 1st (see account of notes further on)."

The dates on which these notes were taken show that the iridescent clouds are not specially connected with any new factor in meteorology, and that they are not connected with any particular kind of sky glows, unless, indeed, glows are connected with some peculiar form of water, and that the conditions required for glow appearances render the existence of iridescent clouds more or less possible.

The recorded observations of many persons are such that they must have mistaken portions of ordinary cloud halos for iridescent clouds, as the descriptions given in their cases are actual descriptions of halos in different positions, with the misnomer, "iridescent clouds."

There are various apparent changes in breadth of the limb of a cloud halo, as its distance from the horizon varies, that render it very possible for an inexperienced observer to fail in recognising a halo in every portion. It is important that future observers should discern the difference between the two classes of phenomena; and the two appended descriptions are therefore fully extracted from my meteorological notes.

Note 1st.—April 17, 1885. Readings are for the previous twenty-four hours—Dry bulb, 59°; W.B., 54°; max. temp., 65°; min. temp., 48°; mean bar., 30·46; barometer falling slowly; temperature rising. Most beautiful sunrise and pre-glow; very fine change of colour, first from the higher clouds, when cross polarization was evident. Then the lower clouds became illuminated in a beautiful manner with various tints, all tints ending in a yellow, after which clouds became white. The clouds, all of a delicate nature, became iridescent when near the sun about 10 a.m. The colours bore no reference to the angular distance from the sun within certain limits; thus the colours were not observed in the cloud patches, whose angular distance from the sun exceeded that of the limb of the pink

Digitized by Google

halo visible at the same time. This halo was beautifully clear and merged into an azure sky. The cloudlets, or cloud-patches, as they approached this pink space became variegated with most beautiful tints. In some cases these tints seemed to follow roughly the sinuosities of the clouds, pink being always at the edge. This pink was brighter than that of the halo into which it merged. The character of the clouds was that of cirrus, or cirro-cumulus. The structure was very delicate, resembling filaments of cotton wool in very loose heaps, with changing iridescent hues. As the clouds approached the sun they got brighter in colours, and as they got within about 6-8 degrees from the sun the edges nearest became tinted with the ordinary colours seen so frequently round the moon, and also round the sun when it is viewed by reflection from a surface of water contained in a vessel deep and black. The iridescent tints observed were pink, green, blue, orange, and mauve; pink being in all cases at the edges. As the clouds coming up, or forming, changed in character to that of cirro-stratus, the colour of the pink halo changed and had a colder tint, until it became overclouded with cirro-stratus. By this time there was no pink halo, but its limb had been gradually becoming more sharply defined and bright, so that by noon it had assumed the definite limb of an ice-cloud halo. As soon as the clouds had taken the character of cirro-stratus completely, the whole phenomena of iridescence ceased. In the evening there was no glow proper, but the clouds becoming a little thinner the halo assumed a pinkish hue. Cross-polarization was observable before sunset. There was a greenish twilight, though not so clear as it is when the clouds are lower and a low pressure area is approaching from the west.

The second note relates specially to the rare phenomenon of a double halo.

Note 2nd.—May 1st, 1885. D.B., 67°; W.B., 53°; max. temp., 75°; min. temp., 50°; m. bar., 30·26. Barometer falling slowly. Wind E.N.E. A bright sunrise; sky full of various tints from very high clouds. Character of clouds, cirrus and cirro-stratus, the colours of the clouds augmented by cross-polarization. At 8.30 a cloud halo was observable, being very perfect, and nearly circular to the sun. The colours, as seen in order from the sun, were red, orange, yellow, green, bluish; the angular distance from sun varied from 18° to 23°. There was a second halo at an angular distance of about 46°, not quite so central as the smaller one. The distance was measured. The colours were in same order as the first series. Both the rings existed until 10 a.m., when the outside one vanished, and the clouds became thicker. The inside halo of about 23° lasted all day, with varying degrees of

Digitized by Google

clearness. The field within it was notably darker than the surrounding portion, which was lighter even than the sky beyond. The limb of the halo became wider as the sun approached the horizon. Presently the underneath side blending, vanished, whilst the remaining portion could well be mistaken for an iridescent belt of cloud. This at last became quenched by the brilliant crimson clouds. No glow existed. Moonlight during evening displayed a similar halo.

It will be seen from the two descriptions just given that frequent mistakes might be made in taking a portion of some halo for iridescent clouds; and as the character of polarization is very obscure, it is almost impossible to distinguish the difference by the aid of the polariscope, and experience in the various forms the halo assumes becomes necessary.

In many instances short pieces of rainbow might pass for iridescent clouds, but they can be instantly detected if viewed through a nicol-prism, as they can be completely quenched with the nicol-prism in radial position.

*The following note is important, as bearing directly on this part of the subject:—A tinted sunrise; sky overcast, with clouds and patchy colours to north-east, but to the west there was a fine exhibition of tinted clouds. The fine high clouds were tinted pink, and their light was polarised in planes passing through the sun, the clouds, and myself. Near the east no change was produced when the nicol-prism was rotated. The colour of the clouds was pink, and very bright towards the west portions of sky, opposite to the sun, which had not yet risen above the horizon to my sight; and a phenomenon existed that might easily have been mistaken for an iridescent cloud. A band appeared, with red to the outside and green to the inside of the circle of which this band formed a part. The inside area of this circle was tinted red, and it was nearly as bright as the red of the portion of ring described. This ring was evidently part of a rainbow, for the nicol-prism completely extinguished it when the long diagonal was at right angles to its circumference. But what was more important was the fact that the red within this ring, and also the red without—though there was not much outside—suffered extinction with the nicol in same position. It occurred to me that if the nicol were directed to the different points of sky corresponding to the position of the unseen rainbow, the light of the red haze would be extinguished with the diagonal of the crystal at right angles to the tangent. Trying this, I found it to be the case.

This is an important note, because of the character of polari-

* This note was inserted after the paper was delivered.

Digitized by Google

zation discovered. The note was taken at Gawler, and I found that at the very time this appearance took place the plains to the west were receiving a heavy rain.

It follows from this that there are several forms of apparent iridescence: the halo forms, rainbow fragments, and the true iridescent clouds; and it is necessary to distinguish between them if we wish to learn much respecting the true iridescent clouds.

The limits of position of such clouds are, in reference to the sun, evident from the notes. Thus they are seen furthest from the sun both at sunrise and sunset, and closest at noon. They are always within the limits of the pink halo, and this is noticeable in connection with the remarkable change in the dimensions of the pink halo from day to day, and from morning to evening, the pink halo being more extended at morning and evening.

When there are two layers of clouds the iridescence does not appear whilst the sun has a great altitude and whilst the one layer of clouds is between the sun and that layer from which the iridescence comes. But on these occasions the iridescence appears when the sun is lower; and then, when the clouds that can become iridescent are illumined at the proper angle, the upper clouds are in such a position that their most illumined portion is not in a line drawn from the eye through the iridescent clouds. At these times the iridescent clouds are most noticeable, owing to the amount of light and the darker background.

The statements here made are corroborated by other observers—Prof. A. S. Herschel, of Newcastle-on-Tyne. T. W. Backhouse, writing of his observations, says:—"Iridescent clouds have been seen at all times of the day, but they have been most strikingly noticeable near sunrise and sunset. Colours don't appear when the clouds are far from the sun, they being then only white during day. * * * * At about half an hour to sunset iridescent clouds have been seen."

J. Graves refers to colours in the clouds like rainbow tints, but not regular, and having considerable altitude, at 26 minutes after sunset.

The reports from Christiania Observatory refer to the great distance of the clouds from the sun at sunset.

These notes show that in all places where iridescent clouds have been noticed they can be best seen when the sun is below the horizon, or when it is somewhat high in the heavens, the iridescence rarely appearing when the sun is just above the horizon. Their relation to particular cloud forms is indicated in many of the preceding notes. Thus they generally seem to precede clouds that come up and take the filmy form, from

Digitized by Google

which the ice halos appear to originate, as my notes show more conclusively than any other notes do. The relation of iridescence to similar clouds in other places than South Australia is shown by the following reports:—

Piazzi Smyth, writing from Edinburgh, says of the brilliant iridescent clouds of December 11, 1884—"Part of the time the iridescent clouds were eclipsed by a heavy cumulo-strata cloud, which showed clearly that the iridescent clouds were cirrus clouds, not as high though as the cirro-stratus haze, acting as a background to show off the beauties of the blue and green iridescent clouds."

The report from Christiania Observatory, already quoted.

The continuation of T. W. Backhouse's remarks. He says:—"The colours appear to be related to thin sheets of cloud-haze, which is white, and not coloured at a great distance from the sun." He describes the iridescence as being on a dense pallium of cirrus clouds. There are other reports supporting these, but it is needless to quote further.

The relation of iridescent clouds to states of weather is also indicated by notes that I have been able to make, and by reports of others. Their appearance is most prominent in all places during the cool months and on those occasions when fine ice-clouds are likely to be forming, or when they have been just disappearing. In Christiania they have been usually observed when mild and dry weather set in after frost. Corroboratory notes come from Prof. A. S. Herschel, T. W. Backhouse, and Piazzi Smyth. Miche Smith, of Madras, states that the appearance of iridescent clouds there is usually noticed before the approach of the monsoons, and these clouds are looked upon as a sure sign of monsoons being near at hand. These periods are the cool periods.

In reference to the spectrum and absorptions, it is sufficient to say that on all occasions the absorption lines have been indicative of dry atmosphere when the sky near the sun has been examined, the blue end of spectrum being relatively brighter, as it generally is when the air is somewhat dry and cold. The tints of the sky are numerous, and each tint has its own particular spectrum, so that a complete account of the tints in the various parts would require a special paper. The only point of value is that the air seems somewhat dry, and that the blue end of the spectrum is relatively brighter, indicating a cold upper stratum. This note only applying to my observations in South Australia.

Methods of observation:—I have tried many ways of observing these clouds. They can be viewed by reflection from substances that absorb part of the light. Thus water contained in a black vessel; surface of black glass; coloured solutions.

Digitized by Google

Water is best where practicable. It should be contained in a deep vessel, so that most of the water is in a deep shade. The colours can be seen very well in this way. In many cases it is preferable to use dark glasses of a neutral tint, as they can be used anywhere. The best way to use them is to stand in the shadow of some building so as just to hide the sun. Then with the aid of dark glasses the brilliancy of the sky is sufficiently reduced to enable the observer to distinguish the colours clearly. A very valuable method consists in the use of nicol-prisms and selenite film, thus obtaining any desired tint as background, and allowing one tint at a time to appear from the clouds.

Digitized by Google

Past Climatic Changes, with Special Reference to the Occurrence of a Glacial Epoch in Australia.

By Gavin Scoular, Corr. Mem.

[Read July 7, August 4.]

[abridged.]

Introduction.—Of the many complex problems with which the South Australian geologist and scientist have to deal none probably are more shrouded in the hidden mysteries of nature than those to which the above heading refers. That the formation known as the "drift deposits," constituting the Adelaide plain and other places, was a consequence of those climatic changes which were embraced by the period of the last glaciation of the southern hemisphere, I think geologists who have thoroughly studied these beds are fully agreed; but whether they, especially those comprised along the western seaboard of the colony, were laid down whilst the Australian Continent stood at a much greater elevation than now, or whilst in a more depressed state than it now is, is a subject worthy of careful investigation.

Traces of a Glacial Epoch in South Australia.—Instances of supposed ice markings, arising from the effects of actual glacial action or otherwise in connection with the Adelaide chain and adjacent seaboard, have been observed and noted from time to time by various geologists. Mr. Selwyn ("Geological Notes of a Journey in South Australia," p. 4) directs attention to a point in the valley of the Inman where he says:—"I observed a smooth striated and grooved rock surface presenting every indication of glacial action. The bank of the creek showed a section of clay and coarse gravel, or drift composed of fragments of all sizes irregularly imbedded in the clay. The direction of the grooves and scratches is east and west in parallel lines, or nearly at right angles to the strike of the rocks, and though they follow the course of the stream, I do not think that they could have been produced by the action of water forcing pebbles and boulders detached from the drift along the bed of the stream." Mr. Selwyn likewise notifies that this was the only instance of the kind he had seen in Australia, and though somewhat struck with the similarity of the markings to those he had formerly seen as ice markings in the mountain valleys of North Wales, he seemed, nevertheless, to retain a doubt in

Digitized by Google

his mind as to whether or not the scratchings he had seen impressed upon the rocks in the bed of the Inman had not at some former period been effected by the agency of running water. This latter hypothesis I am inclined to consider the most probable. As to the whole subject of these supposed ice markings I will endeavour to treat of more in detail subsequently.

The Rev. J. E. T. Woods ("Geological Observations in South Australia," first edition, p. 20), in treating of the geology of the Adelaide chain, says:—"In examining portions of it I have been led to think that probably they were of much greater height at one time. Indeed, it seemed to me, so far as a cursory examination could guide me, that there were very distinct marks of snow and the action of glaciers. This would declare the range to have been once of extraordinary elevation, probably the axis of some former continent."

Professor Tate, in his annual address to the Adelaide Philosophical Society, 1878-9, while treating of traces he had observed of former ice action in South Australia, (1) instances the grooves and scratchings observed by Mr. Selwyn in the bed of the Inman. "Smooth, grooved, and striated rock surface and moraine *debris* at Black Point, forming the southern boundary of Holdfast Bay." (3) "South of Field River, moraine *debris* and masses of transported rocks strewn over the top of the cliffs." (4) "*Roches moutonnées* surfaces of the mica slate on the south flank of Kaiserstuhl, and similarly large rounded surfaces at Crafers; both localities in the Adelaide chain." (5) Also an ice-worn pebble from the River Torrens drift, obtained by the late Sir R. D. Hanson. (6) And likewise near the gorge of the Torrens River there is a stream of *debris* extending along the side of the hill, which the Rev. J. E. T. Woods considers to be the remnant of a former moraine, and in the bed of the river a block of rock is situated, the sides of which are indented with striæ similar to that imprinted by ice action. "Such," the Professor adds, "are the signs of the former existence of ice action in South Australia;" and propounds the following theories as to how this excessive cold might have arisen:—(1) "The prevalence of a very much colder climate;" or (2) "that the land stood at a much greater altitude (say 10,000 feet), or the mountains may have had a more plateau-like form, and therefore need not have been so high, and consequently collected more snow;" or (3) "A combination of both." By these remarks the reader would scarcely know what opinion the Professor holds; but if he turn to the following page of the address he will, I think, be convinced that then, at least, the Professor was of opinion that the elevation of the Australian continent, and that only, had been the primary cause which led to the appearance of glaciers upon

Digitized by Google

the shores of Australia. I am given to understand that since the publication of his geological work on South Australia the Rev. J. E. T. Woods has seen fit to change his mind about the occurrence of a glacial epoch in Australia, and concludes that under the circumstances, and the present acceptation of the term, that it was impossible for a glacial epoch to have occurred in these regions. Returning, however, more particularly to the supposed ice striæ at Black Point, and assuming that the striæ on the surface of the stone there were effected by the passage of land ice, these seemingly ice-striated scores on its surface are impressed upon it in the direction of south and north, and *vice versa*. Guided by this fact, and presuming that the strata upon which the striated block reclines was at the time when the markings upon its surface were effected raised to an elevation of something approaching from 12,000 to 15,000 feet above its present altitude (an elevation of 10,000 feet is not sufficiently great to maintain glaciation either now or during the period of the drift in the neighbourhood of Holdfast Bay). If such had been the case, it is perfectly obvious that the area now occupied by St. Vincent's Gulf must have then been wholly filled with land ice. Therefore the glacier, if it was one, that left its supposed ice impressions upon the stone at Black Point was not by any means pursuing its most direct course to the sea; for according to the direction of the impressions left upon the stone, the glacier's path must have been either north, which is directly inland, or south, which was not at all likely, because in that case the glacier would have had to contend against and surmount the source from which it originated. Whatever may have been the primary origin of these striations, in a great measure at least they must now be confined to the realms of conjecture; yet, after fully considering the whole circumstances in connection therewith, I am led to believe that the furrowings in question were not produced by the action of land-ice. The phenomena, in all likelihood, might otherwise be referable to the original chemical inequalities in the character of the stone itself, the softer parts, after its exposure to atmospheric influences, yielding in a somewhat greater degree to the action of the north winds, and surcharged as these winds most frequently are with silicious sand, the furrowed markings upon the stone, and the path of these winds being in direct parallelism, suggests a hypothesis that the markings may have arisen in the manner described.

Then as to the fact that erratic boulders have been found sparingly strewn over the land surface in the locality of Black Point, and, also, a few, on rare occasions, have been discovered in other parts of the colony, chiefly near the present coast-

Digitized by Google

line. In connection with this subject it might be well to consider that during the peroid of extreme glaciation of the southern hemisphere, the permanent frost-line would stand from eight to nine degrees nearer our shores than it does at present, which would facilitate the passage of icebergs northward to a similar degree as the permanent frost-line extended in that direction. At the same time the eccentricity of the earth's orbit was at a high value, according to Dr. Croll's theory, and cold greatly predominating in the southern hemisphere, whilst the southern shore-line of South Australia we may suppose as submerged to the extent of from 800 to 1,000 feet. Judging from the dimensions of icebergs, noted by navigators in the Southern Ocean at present, the southern shore-line of Australia would then just be about the depth at which bergs of such dimensions might be expected to strand. The watery parts of which they were composed would soon give way to the action of the surrounding warmth, which would be considerably above the freezing point; consequently, the more coherent materials of these stranded bergs would soon drop to the bottom of the sea, and as the land rose the greater portion of this transported *debris* would emerge with it, as a puzzle for the future geologist to determine its origin. It is not at all improbable but that some, at least, of the boulders transported in this manner may have been striated by the action of ice on lands far away, long ere they started on their journey to be exposed afterwards on a distant Australian shore-line.

In his geological work on South Australia the Rev. J. E. T. Woods, (since the date in question I believe the rev. gentleman has altered his mind on the subject of Australian glaciation)—attributes the primary cause of the glacier action he had observed in the Mount Lofty Range to the great altitude of the chain during the glacial epoch. If any extraordinary elevation of the chain ever existed, it must have been long anterior to the date of the glacial epoch to which the rev. gentleman refers. The pre-Silurian rocks, constituting the Adelaide chain, since their deposition have been subjected to vast contortions and denudations; nevertheless, I can discover no evidence to show that the chain ever attained a much greater altitude above sea level than it now attains. It seems to me a much more probable hypothesis that the axial elevation of the range was first determined by some slight undulation of the beds, and for ought we know might have arisen in the ancient sea-bed, which by a succession of upheavals ultimately would become dry land. Denudation then would begin to operate, and the slowly-rising land soon afterwards would become furrowed into inequalities, and as the slopes of the first undulations enlarged, the primary sketch of a mountain chain, with rivers, gullies, and gorges, would be developed.

Digitized by Google

The relation and position which the younger South Australian rocks occupy upon the upturned edges of the old pre-Silurian beds are against the supposition of any very decided change of sea level since the deposition of the former. It will be recognised that no decided movement, either by way of depression or elevation, can have taken place throughout the area of the Mount Lofty pre-Silurian rocks since the deposition of the Yorke's Peninsula lower Silurian beds. These rocks, as exhibited there, are resting almost in a horizontal position upon the upturned edges of the pre-Silurian beds. The seemingly massive character of the beds and the manner of vertical fracturing, indicate to my mind at least that no general movements have occurred, either elevative or depressive, throughout the locality since their deposition. The same considerations are applicable as regards the horizontal condition in which the Miocene beds of South Australia are invariably found resting. Therefore, judging by the undisturbed condition of both the earlier and the later formations, leads me to infer that no upheaval has taken place in the neighbourhood of Adelaide sufficiently important to produce general glaciation of the surrounding country since before the deposition of the lower Silurian beds of Yorke's Peninsula.

According to Dr. A. Geikie, the line of perpetual snow in the Himalaya mountains is 19,000 feet above sea level. These mounbeing situated in latitude 22 degs. north, in round numbers, let us say Adelaide is situated in latitude 35 degs. south, by the same ratio Adelaide would require to be raised to the elevation of 12,000 feet above sea level in order to bring it within the influence of the permanent frost-line. Presuming Mount Lofty to have stood at about the same height above the Adelaide plain at which it now stands, in that case the mount would require to have stood at an elevation of nearly 11,000 feet above the plain to have brought it within the influence of perpetual frost, which height would barely meet the requirements of the theory propounded by Rev. J. E. T. Woods; and much less would it have maintained glaciers at the present coast-line. An elevation of quite 2,000 feet more would be required to have brought these parts within the influence of perpetual frost; for, as already stated, Professor Tate and others have detected signs of former glacial action in the vicinity of our present coast-line. Besides, had any portion of Australia been elevated to the extent of 12,294 feet about 150,000 years ago it could not have been of local application; it must have extended pretty generally over the entire southern portions of the continent of Australia. Had it been otherwise the drainage of the present river systems would have been completely altered by such movements, but which, from evidence

Digitized by Google

obtainable we have every reason to infer has not transpired, at least since before Miocene times.

Evidences of Submergence during the Last Period of High Eccentricity.—Having already pointed out the great improbability that the southern shores of South Australia were invaded with land-ice during the last glacial epoch, I will now endeavour to note a few of the evidences I have collected showing that the seaboard of this part of Australia at least was submerged when extreme cold last prevailed in the southern hemisphere to an extent of over 800 feet.

I am fully convinced that our so-called drift formations, extending at least to an altitude of 800 feet above present sea level, are chiefly of marine origin, and were deposited during the period whilst the last high state of eccentricity prevailed, and whilst the southern hemisphere was passing through its long secular winters of the period. In support of this hypothesis I may state that in well exposed sections of the deposits I have noticed the general characteristics which lead me to infer that the calcareo-argillaceous beds were deposited in comparatively deep and still waters, and which could not possibly have been the debris derived from the meltings of land-ice.

Where the streams from the hills have cut channels through the deposits so that the base of the formation is exposed to view, boulders and pebbles occur, presenting evidence of their having been beach worn. Such water-worn boulders and pebbles I have especially noticed occupying the base of the deposits in the gorge of Smith's Creek and in other gullies where the base of the formation is fully exposed throughout Munno Para East; also from the debris of a well evidently penetrating the basement beds of the deposits. On the western side of the Hummock Range boulders and pebbles of a most decided shoreline aspect have been seen by me also.

At considerable distances from the adjoining hills, imbedded in these calcareo-argillaceous deposits, specimens of drift-wood have not unfrequently been found, belonging to the same species still inhabiting the surrounding heights, which also militates against the theory of the actual glaciation of South Australia during the deposition of the drift deposits. For, as well known to botanists, none of the species of our gum tribe are adapted to withstand the rigours of severe cold, and I am of opinion also that few or none of the species of the land fauna would have withstood the severe change perpetual frost entails. The "Transactions of the Royal Society of South Australia," 1880, pages 27-28, states that nearly every species of our existing fauna lived during the period referred to. As to the appearance and extension of the *Diprotodon australis*

Digitized by Google

and similar congeners during the period, permit me to remark, it was not the actual ice-clad condition of the land surface, but a greater annual rainfall which Australia enjoyed that ushered in these creatures upon the scene. A greater rainfall implies that a more exuberant vegetation than we now possess was spread over the landscape, and following the laws of evolution, a race of animals in every way more powerfully developed is evolved to utilise it.

Inter-glacial, or Pluvial periods—probable date of and duration.—It is now admitted by geologists and scientists generally that the last glacial epoch was periodically interspersed by warm intervening periods of heat. There is indubitable proof from the interbedded character of the seaboard deposits, that during the period of the last glaciation of the southern hemisphere vast climatic changes occurred. As a sample of the many evidences which might be here cited in favour of that view, I will only instance a few which have come more prominently before my notice.

Near Penfield, in the Hundred of Munno Para, section 3,170, a stratum of gravelly material was discovered at a depth below the present surface of from eight to ten feet, interbedded in the calcareo-argillaceous deposits of the Gawler Plains. The locality in which these gravels occur evidently show that they were laid there whilst Australia was enjoying a much greater annual rainfall than prevails at present; and, also, that the sea level was considerably higher than it now is. Likewise, in the same hundred, section 3,160, about 24 or 25 years ago a bed of gravel was struck in an effort made to obtain water, about 20 feet below the present surface, which was also proven to be overlaid and underlaid by the usual calcareo-argillaceous deposits of the plain. Gravels and highly water-worn boulders are also to be seen exposed in the gorge cut by the waters of Smith's Creek in sections 4,158 and 4,161. In this section at least two beds of gravel are exposed to view, the uppermost being again overlaid with from 12 to 20 feet of calcareo-argillaceous material. In section 3,178, Hundred of Munno Para, about eleven or twelve years ago, whilst excavating a water-tank, after penetrating the calcareo-argillaceous subsoil characteristic of the plain, at a depth of about six feet below the surface a bed of gravel from three to four feet in thickness was struck, at the base of which indubitable evidence was shown that a fire not only had been lit there, but that it had been kept in an active state of ignition for a considerable period of time from the large quantity of ashes still remaining within the enclosure of a few stones collected together to constitute the primitive fireplace. Here evidence is forthcoming referring to two branches of physical science. (1) The pre-

Digitized by Google

sence of the gravel bed resting between the calcareo-argillaceous deposits supports the idea that the Gawler Plains not only enjoyed a much moister climate than they now do; and, also, that their relation to the sea level at the period must have been very different from what it was either before or after the event. (2) The excavation also proves that the aborigines of Australia had at that period entered upon the scene; and at that early date of their occupancy they had become sufficiently knowing to erect a rude circle of stones around the fire so as to retain the heat.

As further proof of the interstratified condition of the formation in Gawler West, whilst the late Mr. T. Munroe was engaged in the excavation of a large tank for the purpose of storing rain-water, after passing through from eight to nine feet of the semi-clayey deposits characteristic of the subsoils of Gawler Plains, a bed of gravel was struck, which impressed me forcibly at the time of its having been caused by river action, and, if so, it is evident that the channel of the South Para—a little to the west of its outlet from the hills—then flowed over the plain rather more than 200 yards to the south of its present course; and that its channel was then about 30 feet higher than the level of the bed of the present stream. Similar illustrations may be found in sections given in various papers published by the Royal Society of this colony.

Probable Date of the Last Glacial Epoch.—At the time when I penned my brief sketch of the "Geology of Munno Para" I was under the impression that the last extreme glaciation of the southern hemisphere in point of time had preceded the epoch in the northern hemisphere known as the glacial, and its intensity had begun either about 980,000 years since or about 720,000 years ago. But after reconsidering the subject more carefully I arrived at the conclusion that it must have been in connection with the last term of high eccentricity that a glaciation of the southern hemisphere occurred, which, according to Dr. Croll, took place between 240,000 and 80,000 years ago. At that period a high state of eccentricity continued for a term of 160,000 years, which according to the laws governing the precession of the equinoxes, each hemisphere would pass through during that term about eight periods of extremes in cold and heat. The diversiform character of the summers and winters which then must have prevailed would lead to a much greater rainfall than is now witnessed over the Australian continent, and which would continue in a state of greater or lesser intensity for about 10,000 years respectively.

A Glacial Epoch at the Close of the Miocene Period.—Scanty but indubitable relics are left to show that the continent of Australia was affected by cosmical changes

Digitized by Google

at the close of the Miocene epoch, in a similar way to that which took place at or near the close of the Pliocene period. Though the evidence be somewhat defective, I will here state that the beds known as the "Upland Miocenes" are partly of marine origin, and partly fluviatile and æolian. Therefore whilst the beds were being added to the series by the influence of the two last-named conditions, a vast difference in the temperature of the Australian climate must have prevailed from what we now witness. In the indubitable marine beds at Aldinga Bay and the Murray Cliffs, the more delicate, or what we might term the more tropical species of the fauna, gradually disappear throughout the lower beds of the formation, until at either place the uppermost fossiliferous bed in the series is entirely restricted in its fossil remains to a species of oyster, and that, too, I am credibly informed, is not at present an inhabitant of South Australian waters. Thus a study of the marine beds in question teaches—Firstly, that as the cold was gradually setting in, the molluscan species which are most indigenous to tropical waters disappeared from our shores. At last even the oyster, which is considered to possess a wider geographical range than many other of the molluscan genera, succumbed to the rigours of the increasing cold also. At both localities the bed is overlaid by one known as the non-fossiliferous Miocene clays. These non-fossiliferous clays arose from the azoic character of the waters of the surrounding seas of the period; and that the deposits of a sandy nature, found sparingly distributed throughout the bed, are the æolian accumulations of the period there can be little doubt. As the deposits ascend in height above present sea level the æolian constituents become more prominent in character, until they reach an altitude of about 1,100 feet, when they become, so to speak, the equivalents in time of the calcareo-argillaceous beds of the Adelaide, Gawler, and other seaboard plains.

I have been led to conclude that the whole deposit, in part sub-marine and in part sub-aerial, was formed whilst our earth was passing through one of its periods of high eccentricity, and consequently this change for the time being of the earth's pathway round the sun would naturally lead, in certain latitudes at given periods, to an excessive amount of rainfall, and at others excessive drought; and such extremes of secular change would also lead to a corresponding amount of geological disintegration, and it was during such a period, as it seems to me, that the non-fossiliferous Miocene beds in the neighbourhood of Adelaide and other kindred Australian deposits were developed.

Why the Seaboard Drifts of South Australia are Void of Marine Fossil Remains.—Profound depths and varying tempera-

Digitized by Google

ture of the sea, as is well known, as effectually barricades the free passage of many of the higher orders of marine life from the shore-line of a continent or island, in which they are not native, as high altitudes constitute a line of demarcation to the terrestrial fauna inhabiting two separated plains of a great continent. In this way it is quite possible under favourable conditions that change of temperature alone may depauperate marine life, or may even give an azoic appearance to deposits which are of marine origin. The evidences which have led me to these conclusions — that the South Australian seaboard recent accumulations belong to that class of deposits—are summarily stated in the following sentences :—

Mr. A. Wallace states ("Distribution of Animals;" vol. I., page 447) :—"Between the Fiji Islands, New Caledonia, the Solomon Islands, and Australia, the depth is about 1,300 fathoms, and between Sydney and New Zealand 2,600 fathoms, showing in every case a general accordance between the depth of the sea and the approximation of the several faunas." By referring to a map of the world showing the undulations of the ocean bed, it will be seen that the continent of Australia is surrounded on the south and west sides by a depth of water which at no point is less than 15,000 feet. The sea depth between New Zealand and the islands to the north as well as between New Zealand and the continent of Australia, up to the 25th degree of south latitude, is not less than 15,000 feet, whilst the depth between New Zealand and Sydney is 600 feet more. According to the facts relating to the distribution of life in abyssal depths, as supplied by the Challenger reports, we might infer that little or no direct intercourse can take place at present between the molluscan fauna dwelling in the shallower waters around New Zealand, or her satellites, and the south and east shores of Australia. Also, if we examine the physical and palæontological aspects of these countries, we are led to believe that these conditions not only at present exist, but that a similar state of sea depth prevailed between those countries throughout a vast period of past geological time. Consequently when extreme glaciation pervades the southern hemisphere, a barrier is not only thus set up against the direct passage of the molluscan fauna that inhabit the shores of New Zealand and the islands connected therewith, and the more temperate shores of southern Australia, but it also prevents the free intercourse of the oceanic fauna (if there be any) that inhabit the shores of Victoria and those of New Zealand.

Depending upon the consideration that no very great difference has arisen in the relationship of sea and land within the Australian area since the period of the last great glacia-

Digitized by Google

tion, I am led to conclude that, as the insetting cold advanced towards the equator, the semi-tropical fauna then inhabiting the South Australian area would migrate or creep northward as their natural habitat receded in that direction; and from the profundity of sea-depths which separate adjacent lands from the southern shores of Australia, the South Australian shores would remain depopulated of the higher orders of molluscs so long as this state of cold prevailed. As the cold reached its severest point the sea increased upon the land in the latitude of Adelaide to the extent of from 800 feet to 1,000 feet, and the deposits laid down in that azoic sea when elevated into dry land would assuredly be void of most if not all indications of marine life.

That a somewhat similar phenomenon occurred during middle Tertiary times might have been noted, and that one or more of the species common in the Miocene beds of South Australia migrated northwards at the close of that period and are now found inhabitants of the tropical seas.

It would appear that a somewhat similar theory arose in the mind of Mr. Selwyn to the one I have advanced. He states at page 25 of his "Physical Geology and Geography of the Colony of Victoria":—"The absence of any evidence of marine life may probably be fully accounted for by the character of the deposits, which indicate physical conditions that must have been highly unfavourable to the development of animal life in the area." According to this quotation it seems that the same non-fossiliferous conditions extend throughout the recent deposits of Victoria as prevails in South Australia. Being assured then that so great a similarity prevails *palæontologically* throughout the recent deposits over so widespread a tract of the Australian continent, suggests that these effects were produced by some equally widespread a cause.

By reference to a map of the world we observe that no analogy exists in the distribution of sea and land in the northern and southern hemispheres. In every case the continents that are situated within the former enjoy a diversity of temperature such as that hemisphere sustains; consequently the inhabitants of these lands and the adjoining seas have free access to accommodate themselves to that degree of temperature best adapted to their wants. If the cold of the frigid zone for a time be extended equatorwise, the inhabitants, both of land and sea, of these regions have natural facilities afforded to shift their area of occupancy; or if the heat for the time being of the torrid zone incline towards the north the abode of the inhabitants of these regions is similarly extended. In short, throughout the northern hemisphere, at whatever parallel of north latitude the permanent frost-line may be

Digitized by Google

situated, the littoral, or shore-line inhabitants of the adjoining seas have free access to migrate from north to south, and *vice versa*, in such a manner as to follow the isothermal conditions of their wonted habitat.

Such accommodations, however, are not applicable in every case with regard to the inhabitants of the continents situated in the southern hemisphere. It is true the marine fauna bordering the shores of Southern Africa, America, and Australia have in each case free access to migrate northwards in the event of the isothermal conditions in the southern parts of these continents getting colder. But so far as Africa and Australia are concerned, at least, considering the great expanse and ocean depths that are situated to the south of these countries, it is questionable if the existing fauna were driven northwards by an increase of cold, whether the breaches thus caused in the ranks of animal life in these regions would be immediately replenished by others indigenous to a colder habitat. With regard to Australia, New Zealand might be looked upon as being a sort of halting place in the passage of marine life passing between the frigid waters of the antarctic circle and those of a more temperate character which encircle the southern shores of Australia. But if the depth of sea be considered which lies between the shores of Victoria and New Zealand, it becomes almost an impossibility that such a highway could have been available for the migration of animal life during the time of the last extreme glaciation. The resembling character existing between the non-fossiliferous clayey Miocene beds, also the upland Miocenes, and the more recent deposits constituting our seaboard plains, forcibly show that all were originated in a similar manner.

Since the foregoing was written I have revisited the grooved and striated rock surface at Black Point, Holdfast Bay, and from what I then saw and could determine, the views as stated in this paper regarding the phenomena were fully substantiated. On the top of the sea-cliff, where the surface of the bed-rock has been exposed to the action of the north winds and that of the sea for centuries, the grooved and striated rock-surface rest, and consists of a bed of hard, slightly micaceous, schistoze rock, occupying very nearly the anticlinal apex of one of those minor folds of so frequent occurrence throughout the pre-Silurian rocks of South Australia. The strike of the bed upon which these interesting striations are impressed is in a parallel direction with the furrowings, which are south-south-west by north-north-east, and dip at an inclination of from six to eight degrees to the west. Another peculiarity I observed on revisiting the scene of these striations (which, to my mind, have

Digitized by Google

a tale to tell against their being of glacial origin) is that the striæ on the rock-surface in no case are prolonged below the recent deposits, unless where they are of sub-aerial origin. Such proofs strongly lead me to believe that the striæ in question are not of ice origin, but were effected by other agencies at a period subsequent to that of the last great ice age.

As a further corroboration of the opinion that these striæ on the rock-surface at Black Point are not of glacial origin, on revisiting the locality I discovered about fifty yards north-easterly, in the bed of a small stream, similar markings to those observed at Black Point, showing evident signs of their having been effected by atmospheric and aqueous agencies; with this marked difference, however, that they were impressed upon the rock-surface in the direction of nearly east and west. This fact still further convinces me of the opinion that some of the beds in that neighbourhood are not composed of equally destructible materials, so as to withstand the wear of time in a uniform degree. The markings on the top of the sea-cliffs, to my mind, are referable to atmospheric and æolian agencies, whilst those of the watercourse have been caused by the combined action of the atmosphere and the little streamlet.

Digitized by Google

ɔcene Climate in South Australia

(part a rejoinder to Mr. Scoular's Paper).

Professor Ralph Tate, F.G.S., F.L.S., &c.

[Read August 4, 1885.]

ver advocated with any earnestness that climatic high value are due to geological rather than cos-; and in a course of public lectures, delivered last University, I applied Dr. Croll's hypothesis to the of certain physiographic peculiarities of Central hich are co-ordinate with the glacial signs in the rt of the province. I have had long in preparation "Climate past and present in its relation to the of animal and vegetable life in Australia," an out-h formed the basis of the lectures above referred wish to know by actual observation the physical the basin of Lake Eyre has stayed my pen. It is, ith much reluctance that I am forced into this before I am prepared to encompass the questions all their manifold bearings.

s.—These and other signs of moving ice are now uth Australia, at altitudes from 50 to about 2,000 sea level. They have been examined by several well versed in reading such signs in Canada, in, and Central Europe, who have without excep-tatingly attributed them to the action of ice. In nilar phenomena have been observed by Griffiths . In the face of the facts, thus daily accumulating, e daring men to dispute that *Southern Australia imate sufficiently cold to originate glaciers at compara-vations.* The strenuous opponents to such generali-Professor Hutton, of New Zealand; Dr. Lenden-ney; and Mr. Scoular, our corresponding member. tton inclines to the opinion that the glacial period a could not have been so severe as is demanded by nal and geographic range of the ice-marks observed stralia and Victoria, else the simultaneous glacial ew Zealand would have been of polar severity, which was not because of the great abundance of animal ime. He writes*—"Neither are there any signs of a glaciation of New Zealand greater than at present."

* Quart. Journ. Geol. Soc., vol. xli., p. 213, 1885.

Digitized by Google

Prof. Hutton does not make it clear to my comprehension that the Pleistocene deposits so rich in bird remains were coeval with the glaciation of the southern hemisphere. One circumstance which seems to very much invalidate Prof. Hutton's arguments is that New Zealand has been the scene of great oscillation of level during Tertiary times; "the Oligocene and Miocene systems attain an elevation of 4,000 feet in the North Island;" "the marine beds of the Pliocene system attain an elevation of more than 2,000 feet near Napier;" and in the Pleistocene period "I believe that the sea stood much higher than 800 feet in Canterbury," *op. cit.*

[*P.S.*—August 15. More recently Prof. Hutton has modified his opinion, as I gather from the following abstract of a paper read before the Lin. Soc. N.S.W., July 29, 1885:—"The author discusses the phenomena which have been adduced as evidence for the former existence of a glacial epoch in Australia, and shows that they are susceptible of a different interpretation. He distinguishes between a glacier epoch, such as has occurred in New Zealand, in which, owing to various local, but only local, causes, icefields prevailed over much larger districts than at present, and a glacial epoch, such as has been demonstrated in the northern hemisphere, which is the result, not of variations caused and limited by local circumstances, but of alterations universal or cosmical in character. The glacier epoch in New Zealand is regarded as anterior to the glacial epoch of the north."]

Dr. Lendenfeld* characterises my observations† as very vague, and Mr. Griffith's‡ evidence as of a still more vague character. Did I not know that Dr. Lendenfeld has had a large practical alpine experience, I should have been disposed to regard his statements as indicative of incompetency to appreciate at their proper value glacier signs irrespective of their position. It seems to me that his main objection to the acceptance of the observations of myself and others is that we began at the wrong end. He writes:—"Glacial traces must be looked for in the mountains first," and then when found "the investigation can be extended down to the low lands to ascertain how far the glaciers reached." Indeed, I cannot refrain from remarking upon the obvious under current of self-laudation running through his paper—as it were to say, I will ignore all these evidences as I wish to have credit for the discovery of glacial remains; of course up the mountains I will go. And he found them on the high plateau of Mount Kosciusco, but not below 5,800 feet, and concludes that "at the time of the

* Proc. Linn. Soc. N.S.W., vol. X., p. 2.
† Trans. Roy. Soc. S. Aust., vol. II., page lxv., 1879.
‡ Trans. Roy. Soc. Vict., 1882.

Digitized by Google

glaciation of the southern hemisphere the climate was then not very cold, so that the glaciers only covered the highest part of the Australian Alps, and it is not likely that glaciers existed anywhere else in Australia at the time." Doubtlessly in a certain sense we should look rather towards the high elevations for glacier signs, as there the glaciers would be the last to disappear; but as the lowland tracts may have longer preserved the scorings, scratchings, and other evidences of the passage of land ice by the protecting superficial coverings laid down over its retreating path, we may hope to be more successful in a search here than at the highest elevations where the process of weathering is so much more energetic and persistent. So far as regards the higher levels of the Mount Lofty Range, ice marks are not at all likely to have been preserved on the friable sandstones which everywhere crown elevations above 1,800 feet.

[*Postscript.*—Dr. Lendenfeld "draws attention to some further evidences of ice action in the Mount Lofty group, near Adelaide, where some glacier-polished rocks, with some very well preserved striæ have been discovered and photographed."—Abstract of Proc. Lin. Soc. N.S. Wales, July 29, 1885. In the absence of particulars I cannot be positive, but there is strong circumstantial evidence that this so-called discovery relates to the ice-worn surface at Black Point, Hallett's Cove, which was photographed by Mr. H. Y. L. Brown, Government Geologist, copies of which were sent by him to Sydney. Following upon the very severe strictures on the observations of self and others in reference to the presence of glacial signs, this admission of Dr. Lendenfeld—the prince of sceptics—must remove all doubts as to their value.]

Mr. Stirling* has recently announced the presence of ice-worn and scratched rocks and other glacial signs at elevations as low as 1,000 feet above sea level in the Omeo district, Victoria.

Mr. Scoular's antagonism is the most serious, because he has examined the glaciated surface at Black Point, which he attributes to the action of blown sand; but I will defer for awhile my criticism on that gentleman's observations and deductions that I may now deal with a phase of the inquiry of fundamental importance, namely:—

THE EXTINCTION OF THE ARID AREA IN AUSTRALIA DURING THE GLACIAL EPOCH.

It seems to me that the authors so strongly opposed to the glaciation of southern Australia take for granted that it never existed, and therefore reject the evidences as vague, or explain

* Roy. Soc. Victoria, July, 1885.

Digitized by Google

them away by the aid of other agents. Moreover they have proceeded on the assumption that the annual temperature at any one place was affected during cosmical changes in proportion to its distance from the advancing or retrograding wave of glacial cold; that the environments remained the same, and therefore by rule of proportion the increment or decrement of heat was invariable. Thus, then, the main grounds of rejection of the evidences of glaciation may be briefly stated as follows:—That the existence of glaciers is incompatible with the high temperature that must have prevailed over this area during the glacial epoch of the southern hemisphere.

If the east coast of the South Island of New Zealand were known only, with what incredulity would have been received the announcement that the transalpine glaciers reached to within 700 feet of sea-level, or 2,000 feet lower than those on the east slope. Of course we understand the why and the wherefore; but had we formed preconceived notions touching the climatology of the western region, based on eastern experiences, how erroneous would they have proved.

Existing causes tend to maintain a higher mean temperature for southern Australia than is demanded by its latitudinal position, and to these Dr. Lendenfeld appeals as fatal to the existence of glaciers except on the alpine plateaux, even at the period of extreme cold; and Professor Hutton argues much in the same way. But were these causes operating with the same intensity always as now? I think not; and their removal and the reciprocity of actions in consequence thereof may have resulted in the production of a climate which, compared with the present, may have offered as great a contrast as those of the eastern and western slopes of the New Zealand Alps.

To state my case:—If we study the present distribution of temperature and aqueous precipitation on this continent, we shall recognise a central arid area from which all around the rainfall increases—tropical rains to the north and winter rain to the south of it. Here in this almost rainless region originate those desiccating winds, which materially elevate the temperature of the southern shores. Guyot has shown that the existence of a dry belt on either side of the tropics is due to permanent laws governing the motion of aerial currents. The locus of high barometric pressure or descending equatorial air column has a seasonal motion within certain limits—being dependent on the position of the sun in its annual path; so also will it be affected by changes in the obliquity of the earth's orbit. The area of high pressure, or of aridity, has an annual oscillation, and must have also a cyclical one. This

Digitized by Google

being so, and given the southern hemisphere its maximum of cold and the high latitudinal position of the sun in the northern hemisphere, it follows that the system of trade winds in the southern hemisphere is shifted further north, and with it those other effects which are correlative, bringing our southern shores into the region of copious summer rains, and Central Australia within that of winter rains. More than this, the dry belt would be shifted so far to the north as to be almost obliterated, or, at least, greatly narrowed by its proximity to oceanic waters.

Under such influences the climate of Southern Australia is changed in a way not hitherto foreseen, and the question, did perennial ice exist on its mountains? is not so difficult to answer. By induction we should have been led to anticipate the discovery of those glacier signs, the interpretation of which has created so much unnecessary controversy.

A glacial period and a pluvial period mean the same to me, being referrible to the same cause—rain or snow—according to latitude or elevation.

I have persistently argued for some years that the rainfall has greatly diminished since the Pliocene period, the evidences of which are more striking in Central Australia than in more southern latitudes because of the present poverty of rain there.

A vastly increased rainfall over what is now the arid region of Australia in former times is demanded by the extinct rivers and lakes and the former existence of large herbivores.

1. The Extinct Rivers.—All the watercourses which originate within the dry belt are characterised by the absence of water. It is only towards their sources that they collect the surface drainage, and then only at distant intervals of time. Many of them are of great width and are traceable for more than 100 miles to the depressed area around Lake Eyre, where they become obliterated many miles from the present shore. The Paroo and other of the north-western tributaries of the Darling no longer carry water in their lower sections. The volume of discharge from the River Murray must have been many times greater than now. (See my paper on the River Murray, p. 30, et. seq., vol. VII. of these Transactions).

2. Extinct Lakes.—Lake Eyre is the centre of the continental drainage, and is maintained at the present time by the flood-waters of the Cooper and Diamantina, which are supplied by tropical rains. But toward this extensive depression there are directed many dry river-beds, whilst hundreds of square miles around the present lake margin are covered with sandhills, separated by loamy interspaces, which are littoral sandbanks marking the successive stages in the contraction of the water

Digitized by Google

expanse. The basin of Lake Torrens exhibits the same peculiarities as that of Lake Eyre; the margin of the former lake is 111 feet above, whilst that of the other is 39 feet below sea level. The river courses of the Lake Torrens basin are short and rapid, the rainfall is a little more, and not unfrequently the creeks discharge their contents into the lake.

With the features of the Lake Torrens basin I am familiar, and will submit now the chief facts which induce me to the opinion that the present lake is but a remnant of its former self, and that the sandhills are of lacustrine origin.

The plain of Lake Torrens is at its margin chiefly composed of loams and gravels, shed from the adjacent slopes, or transported from the far distant Flinders Range by the torrential streams which debouch upon the plain; other constituents of the gravel are flints and agates quite foreign to the district. Here I picked up a pebble of obsidian. Further out on the plain these drifts are concealed by low, more or less parallel, sandhills separated from one another by loamy flats. The wide trumpet-shaped mouth of the valley of the Aroona River is occupied with breccia and conglomerate to 50 and 80 feet above the level of the present stream course.

The sandhills have a trend conformable with the edges of the main body of the drift, which is by estimate at least 100 feet above the level of the lake-waters. The sandhills are covered with vegetation, and are quite stable. The sand is coarse, sharp, and externally red coloured; angular fragments of white quartz and dark-coloured quartzite up to five millimetres diameter may be gathered at the bases of the sandhills. No fossils have been detected in the sandhills, but the loams have yielded remains of land vertebrates.

3. Extinct Fauna.—That the lake areas of Eyre, Torrens, and Frome were once inhabited by terrestrial and fluviatile animals now totally extinct or repelled is a well established fact; perhaps no other part of Australia has yielded such abundant remains of *Diprotodon* as that about Lake Eyre. Unfortunately the sequence of the beds yielding mammalian and other terrestrial remains is not known; but whether they be isochronous or not—tableland sandstones, the deeper-seated clays and gravels, the more superficial loams, or the sandhills—they all indicate a lacustrine origin. Mr. Debney† obtained fossils from the escarpment of a table-hill, between the Warburton and the Cooper, on the east side of Lake Eyre, in the midst of the sandhill country. They consist of the phalanges and other bones of an emu-like bird, crocodilian scutes and teeth, chelonian plates, and vertebræ of fish. Similar organic

† Trans. Roy. Soc. S. Aust., vol IV., p. 140; 1881.

Digitized by Google

debris were obtained in a well-sinking near Lake Hurd, north of Billeroo trig, in the basin of Lake Frome; they occurred in a stratum of sharp white sand underlying a clay which is reported to me to have embedded in it stems of "mulga" (*sic*). At Kalamurina Station, near Cowarie, on the Warburton river, about 50 miles north from the first-named locality, and in the same physiographic region, there has been exhumed the fore part of the skull of a crocodile, differing from *C. porosus*, inhabiting tropical Australia, by its shorter, broader, and more massive snout. The specimen graces the Museum at Port Adelaide.

In this connection may be reported the discovery of the lower jaw of *Macropus Titan* and mandibular teeth of *Ceratodus Forsteri* in the bed of a dry lake near Momba Station, about 25 miles north of Wilcannia. The fossils were gathered by Mr. W. Hogarth, and presented by him to Mr. Gavin Scoular, who has obligingly submitted them to me for determination. The former gentleman writes to the latter that the lake is, according to the statement of the Astronomer Royal of Sydney, 350 feet above sea level, and that at times of high floods is filled by the waters of the Darling river, but has not been so until the one of this year since 1864; that after the flood of 1864 cod and other fish were caught in the lake. The highly mineralised condition of the organic remains above referred to is suggestive of their having been washed out of a red loam or earth, and precludes the probability of their recent origin.

As I have elsewhere* pointed out, the existence of the gigantic herbivores in the "dry zone" demands climatic conditions favourable to the growth of a vegetation capable of supporting them, and that their extinction is attributable to those climatic changes which brought about dessication, involving a reduction in volume of the waters of the lakes, and finally converting their basins into saltpans.

I need hardly urge that the replacement of the arid plains by freshwater seas, though a consequence of an amelioration of climate, must have had a reciprocal effect, conversely as the existence of a dry zone produces aridity and thereby intensifies the effect.

Specific Criticisms on Mr. Scoular's Paper.

The Ice-marks at Black Point are on sheared surfaces across the bedding, and their direction is nearly parallel with the trend of the coast. But the consideration of the direction of the marks is of little moment, as we cannot restore the outline of the country at the period of their production for reasons hereafter to be stated.

* Trans. Roy. Soc. S. Aust., vol. II., p. lxvii., 1879; vol. VII., p. 32, 1884.

Digitized by Google

It is easy to attribute each isolated feature of glacial phenomena to some other cause; but will any other agent than glacier ice satisfy all of them, taken collectively?—the shearing of rocks, furrowed, scratched, and polished surfaces, and morainic debris.

Mr. Scoular has unwittingly succeeded in contradicting himself by attempting to prove too much. When having satisfied himself that the glaciated surface at Black Point is the result of the attrition of blown sand he appeals to similar markings "showing evident signs of having been affected by atmospheric and aqueous agency—the combined action of the atmosphere and the periodic waterflow."

Elevation of sea level and origin of Pliocene Drifts.—The application of Croll's hypothesis demands, according to the opinion of Mr. Scoular, the elevation of the sea level around our shores to 800 or 1,000 feet. This may be true, but if the land has not moved since then our drift-beds should be marine; yet, Mr. Scoular has failed to prove them to be so, whilst the palæontological evidences strongly favour the view of their subærial origin.*

I am unacquainted with marine Pliocene beds in South Australia, or even in Australia. We have nothing equivalent to the Wanganni system of New Zealand, therefore the marine equivalents to the Pliocene Drifts, if extant, are submarine. If, therefore, an elevation of the sea level to a height of about 1,000 feet took place during our glacial period, and as no cotemporaneous marine debris occurs, it is a necessary deduction that the land stood so much higher then than now, to escape the submergence.

Again, if the low level plains are of marine origin, why not the upland plains, which present the same characteristics? In the case of the Willochra plain, an elevation of sea level to a height of 1,500 feet is required for its marine origin; in the case of the Terowie plain, rather more; and in that of Yarcowie, close upon 2,000 feet. Here Mr. Scoular is very inconsistent, for, while inadvertently admitting the lacustrine origin of the high plains, he will not apply to them the same arguments which lead him to attribute a marine origin to the low-land plains. Surely if the vast area—more than three-fourths of the whole settled parts of South Australia—had been buried beneath the sea some vestiges of its marine fauna would have been forthcoming.

Further, a greater elevation of the land is demanded by the extension of the drift deposits below sea level. In the Adelaide bore the drift beds have a thickness of 69 feet, their base

* Trans. Roy. Soc. S. Aust., vol. II., pp. lxii., et. seq.

Digitized by Google

wever, 70 feet above sea level; but on the western
e Older Tertiary escarpment at Adelaide the drift
t deeper levels and are projected below low-water
Ioldfast Bay. In the Port Wakefield bore these beds
omed at 312 feet below sea level, and throughout
kness are highly charged with carbonaceous muds. In
g bore, near Port Augusta, the base was not reached
t, corresponding to a depth of 356 feet below low-
rk. Here, also, carbonaceous muds were passed
nd a few fragments of crocodilian scutes were ob-

ot been definitely proved that the deposition of the
Drifts was contemporaneous with the existence of our
ut their mode of occurrence, nature, and organic re-
ly great aqueous precipitation during the period of
mulation, and therefore presumably coeval with the
enomena. The view of the lacustrine origin of the
he lowland and upland plains may seem at first diffi-
ceptance, because of the necessity for barriers across
er ends to impound the drainage. Actual barriers are
ble in a few cases, as that formed by the Older Ter-
rpment at Adelaide, through a gap in which the River
ow flows; a similar feature is seen in the valleys of
and Gilbert, near Hamley Bridge. In most of the
lains the flanking hills converge at the lower end,
ne to suppose that at deeper levels they increasingly
one another to form a gorge; but in most cases the
ths to which the old valleys have been filled precludes
f ever learning much on this point. As to the great
n of Central Australia, the configuration of the pre-
ce permits of a vast increase in the area and depth of
in each basin. In the case of the Adelaide Plain, its
origin demands a barrier across what is now St.
Gulf; but the truncated margin of the drift around
s and the depth below sea level to which the
ends at Port Wakefield, indicate that the gulf has
avated out of the drift beds. From this and other
nces it is not possible to restore the configuration of
surface immediately prior to the glacial period, and
the pre-existence of barriers must remain an assump-
lso that the building up of terminal moraines may
the primary cause of the filling up of deep valleys
erial detritus. Mr. Scoular argues against any EXTEN-
EAVAL OF THE LAND, because "the drainage of the
iver system would have been completely altered."
act that the River Torrens has cut its way across the
n of the strata in deep gorges and contrary to the

Digitized by Google

natural drainage of the country indicates that the formation of its bed took place prior to the development of the present configuration. The valley and gorge of the Lower Onkaparinga is another example of an old river system.

Existence of Gum-trees Incompatible with a Glacial Climate.—Mr. Scoular has referred the drift-wood found in the Pliocene beds to living gum-trees, but on what evidence he does not tell us, though doubtlessly true. But his statement that gum-trees do not grow at high altitudes is erroneous, as there are several subalpine species—*E. amygdalina* ranges to 5,000 feet on the Snowy Mountains, whilst shrubby states of other species locally known as "snow gums" ascend to the edge of the highest plateaux at 6,000 feet.

Marine Origin of the Upland Miocene.—Mr. Scoular does not adduce any proof of the marine origin of the gold-bearing drifts and coterminous deposits which range up to altitudes of 1,000 feet or thereabouts, and ignores the evidences furnished by their mechanical condition and the embedded vegetable debris. His facts touching the molluscan life of the youngest member of the marine Miocene deposits are very incomplete, and his deductions therefrom are very fallacious. It is true that oysters dominate the beds, but they had for associates several species of Pecten, some closely allied to the recent species *P. australis*, *P. bifrons*, and *P. pleuronectes;* the living *Placunanomia Ione*, and *Lucina dentata*, *Trigonia acuticosta*, a *Meleagrina* very near to *M. margaritifera*, *Cucullæa Corioensis*, a large *Donax*, and several other bivalves. Among gastropods *Cassis textilis* and *Haliotis nævosoides* are conspicuous; in other classes *Clypeaster Gippslandicus* (McCoy) and *Balanophyllia* sp. are noteworthy. If we may predicate climate from such an assemblage, it would not be in the direction of a colder climate than which now prevails over the same area. The apparent paucity of species in the oyster beds is probably due to destruction of their shells by the solvent waters freely admitted by these incoherent and superficial beds, as the majority of the fossils are those with calcitic tests.

Summary.

1. That the evidences of the glacier period in South Australia are numerous and pronounced, and reach as low as present sea level.

2. That the glacial phenomena were not local, but are attributable to those cosmic causes which produced glaciation at a more recent period in the northern hemisphere.

3. That the extension of the subaerial deposits of the glacial period below sea level demands elevation of the land at the period of their accumulation corresponding in amount at the

Digitized by Google

with that of their present submergence. (Four hundred ctually known.)

It is highly probable that upheaval was an important r of climatic change at this period. The relationships of ost-Miocene faunas and floras of the continent with those e large adjacent insular masses demand a more intimate ection with the continental area than that which now ob- ; this was probably furnished by elevation of the sea bed. That the present arid zone of Central Australia was, g the glacial period, a region of copious rainfall, of fresh- seas, and perennial rivers ; now a barrier to the comming- of the south-western and eastern floras and faunas ; it, at time, was doubtlessly the line of migration of the eastern es of south-western generic types, and *vice versa*.

Digitized by Google

Remarks on the Nomenclature of some of the South Australian Butterflies, with Observations.

By E Guest.

[Read September 8, 1885.]

Having given much of my leisure time during the last six years to the study of such of the Lepidopterous fauna as are to be found in the neighbourhood of Balhannah, I wish to place some of the results of my observations before the Society.

It is quite a mistake to suppose that butterflies and moths are scarce in South Australia; in places they may be, and the Rhopaloceræ are certainly not abundant in species, but all other families are extensively represented, and only want looking for. As a proof of this I may mention that I have taken nearly 500 species within a radius of three miles of my house, and am continually finding fresh ones. A very fair percentage of these have turned out to be new to science, of course chiefly among the micros, although out of 45 species of Geometrina nine were returned as "not previously described." This makes it very evident that to get anything like a fair knowledge of our fauna we must have more workers, and knowing by experience the disheartening nature of the pursuit, through the difficulty of obtaining correct specific determinations, I thought that I would make an effort to get the nomenclature cleared up, so far as my limited knowledge and opportunities would allow me.

For this purpose I have remitted specimens of all the doubtful species of butterflies that I possessed to Mr. E. Meyrick, B.A., &c., of Sydney, whose kindness and courtesy I cannot speak too highly of, asking him at the same time to identify all that he could of such species as are mentioned in Mr. Tepper's papers, but of which I did not possess specimens. The results of our correspondence I now epitomise in the following list, which I believe is correct so far as it goes, but unfortunately the species of Hesperidæ and Synemonidæ are difficult of identification without specimens, and many of Mr. Tepper's are consequently omitted.

As will be seen, our new species have been ruthlessly cut down—in fact, I very much doubt if there be a single butter-

Digitized by Google

ıer list that has not been previously described, and number of species given is much understated. The ıdeavour may, however, be of assistance to any be- tending to pursue this subject as a prelude to the ɛresting, though more difficult, study of the other —

ınippe (*Don*).—Occasionally seen, but not common, at annah. April and after hybernation, in September.
ɾpalyce (*Don*).—The figure of this species represented r. Tepper's paper (p. 3., fig. IV.) is not harpalyce at ut the male of P. aganippe. The true harpalyce may once recognised by the large red spots on the under- which are wanting in the aganippe.
ıilax (*Don*).—Common at Balhannah some years, ıt in others. October.
itea (*Fabr.*).—Pretty common. March and in the g, after hybernation.
cardui (*L.*).—Very common.
elleda (*Fabr.*).—Very common.
Klugii (*Guerin*).—Very common, but only single- led in the hills. October and November.
hanta (*Don*) ; Las ocrea (*Guest*).—Local, but gene- abundant where it occurs. Scarce at Balhannah. mber and December.
mpha merope (*Fabr*).—One of our commonest insects n November. The male soon disappears, but the le keeps about all the summer, but is never, I think, the following Spring.
ırysippus.—A rare insect here. March, and hyber- .
ippus (*Cram.*).—I have never taken this insect at annah, but it is very common at Norwood.
?, spec.—I take one fine species of this genus ɛre some years not uncommonly, but as yet have not eded in getting it identified (perhaps I. icilius). Mr. er's Cupido œneus is also of this genus, but of which es is uncertain.
iscifer (*Herr Schäff*).—A common insect both here nost places. It frequents open grassy paddocks in ıeighbourhood. November.
Bœtica (*Lin.*).—Not very common most years ; flies fast. September and October, and again some years e end of April.
ɔgricola (*Hew*).—Generally common, but not often vith here.
rinus (*Fabr.*).—This is Mr. Tepper's Cupido simplexa. urs here, but not very commonly, frequenting thick

Digitized by Google

bushy paddocks in November. The Balhannah specimens appear rather smaller than Mr. Tepper's specimen.

Lycæna alsulus (*Herr Schäff*).—This is Tepper's Cupido delicata, and my L. purvulgatus. Common all the year round. Varies greatly in size.

Lycæna biocellata (*Field*).—Is Tepper's Cupido adamapuncta. A common insect here, and widely distributed, extending to Fiji. November, &c.

Lycæna serpentata (*Herr Schäff*).—This is Cupido fasciola of Tepper, and C. molybdena of my list. It appears to be nowhere very common, but distributed all over the colony, Mr. Meyrick having taken it at Quorn. Out in October, and may be occasionally found all through the summer in grassy places.

Lycæna Heathii (*Cox*).—This is the L. paradoxa of my list; it is not included in Mr. Tepper's. During the last two years I have taken it rather plentifully, and it appears to be widely distributed. Out in October, and I think must be double-brooded as I also take it quite fresh in March.

Ogyris otanes (*Field*).—This is not taken here; but I have included it on Mr. Tepper's authority, as there can hardly be any mistake in such an insect as this.

Trapezites petalia (*Hew*).—This is Hesperilla quadrimaculata of Mr. Tepper. I have not as yet seen it here, but it appears fairly distributed.

Taractrocera papyria (*Boisd*).—This is my Hesperilla fumosa; it does not appear to be included in Tepper's list. Is locally common here, and is widely distributed.

Synemon sophia (*White*).—Is Mr. Tepper's S. læta. It is common here, and is taken all over the colony, but appears to be peculiarly South Australian. The true S. læta is quite a differently marked insect.

Synemon theresa (*Dark var.*).—Is Mr. Tepper's S. obscura. I take it here, but not commonly.

Digitized by Google

Descriptions of and Notes upon the Species of the Genera Murex and Typhis, known and recorded to Exist on the Coast of the Colony of South Australia.

By W. T. Bednall.

[Read September 8, 1885.]

In presenting this paper to the Royal Society of South Australia I am actuated by the wish to place such information as I have obtained on the subject at their disposal, and also that through this channel the same may be communicated to authors, students, and collectors elsewhere. Mr. G. W. Tryon's "Manual of Conchology," a recent and most valuable work, comprehending all the known species up to the date of publication, has afforded me considerable assistance in checking our own species, but at the same time it has shown me that conchological authors and collectors are still very much at a loss for authentic information as to the habitats and local distribution of many shells; indeed, notwithstanding the zeal with which in these days of scientific travelling and exploration every corner of the globe is ransacked for new treasures, the number of species still with "habitats unknown" attached to them is remarkable. As Conservator of one of the most magnificent collections in the world — that of Philadelphia — Mr. Tryon, has facilities for comparison and reference that cannot possibly be enjoyed by students in distant countries; and the same may be said of the curators of the splendid museums of England and the Continent. But in their limited sphere local collectors have opportunities of doing service to science by distributing specimens and recording personal observations, by which means the many difficulties of identification which so sorely trouble the naturalist will gradually be lessened, and authors will be saved the unpleasantness of again and again giving new names to the same shell. As an instance in point, one of the species included in this paper is fettered with no less than four different names, besides a probable fifth.

We have five recorded species of Murex, four of which are known to local collectors.

Genus Murex, Linnæus.

M. (Pteronotus) triformis.—Reeve, *Conchologia Iconica*, pl. 13, f. 53.—Shell angularly elongate and absolutely triangular

Digitized by Google

in looking at it with the spire in the foreground; spire two-fifths the length of the body whorl; whorls six, angulated towards the upper part and slightly nodulous between the varices, transversely striated, the grooves increasing in width and ending in a delicate frill on the varices of the body whorl; varices with a single open projection or spine posteriorly both on the spine and body whorls in a line with the nodosities; aperture ovate, but sinuating considerably posteriorly near the outer lip; canal somewhat long, not quite closed, and in most specimens increasingly open towards the anterior end, which is strongly recurved; outer lip finely crenate; inner lip smooth, spreading over the columella; colour fulvous brown, in most specimens increasing to deep purple, while others again are of a creamy white; inside white; length 3 inches, breadth 1.3 inch.

Distributed generally throughout South Australia. Dredged at a depth of from two to ten fathoms in St. Vincent's Gulf.

King George's Sound, Western Australia.

Tasmania, where, however, the specimens are much smaller.

A very pretty shell when in good condition. The varices form an elegant frill nearly the whole length of the shell, which is especially conspicuous on the margin of the outer lip, and, in perfect specimens, the recurved canal becomes a strong hook.

M. (Pteronotus) Angasi.—Crosse (*Typhis*) *Journal de Conchyliologie*, 1863, pl. 1, f. 2, *M. eos*, Hutton, *Manual of New Zealand Mollusca*, 1873.—This small species has the general appearance of young examples of the preceding one, but the varices at their juncture with the suture are very canaliculate and much hooked backwards. In the spaces between the varices are two or three small rounded close canals of varices, giving the shell the appearance of a Typhis, in which genus it was placed by M. Crosse. Last whorl larger than the spire; aperture small, nearly oval; columella arcuated; outer lip large and foliaceous; canal slightly oblique and recurved backwards; length 6, breadth 3 lines.

St. Vincent's Gulf (Tate); Port Lincoln (Bednall).

Tasmania (Atkinson).

Port Jackson, N.S.W. (Angas).

New Zealand (Hutton).

M. (Phyllonotus) octogonus.—Quoy and Gaimard, *Voyage of the Astrolabe*, vol. ii. p. 531, pl. 36, f. 89. *M. scalaris*, A. Adams, *Proceedings of the Zoological Society, London*, 1853, p. 71. *Trophon umbilicatus*, Tenison Woods, *Pro. Royal Soc. Tas.*, 1875. (?) *M. Brazieri*, Angas, *Pro. Zool. Soc.*, 1877, p. 171, pl. 26, f. 3. Shell elongately oval, solid, spire pointed, about half the length of the shell, and a trifle longer than the aper-

Digitized by Google

ture; whorls 5-6, spirally grooved, rounded, angular at the upper part and slightly concave at the suture; strongly varied longitudinally, the liræ made by the spiral grooves ending in open foliations on the varices of the body whorl, which are eight in number, and terminating in the vicinity of the umbilicus in coarse raised laminæ; outer lip finely notched on the margin and crenate internally; inner lip smooth, spreading over the columella; light fulvous brown, ribs deeper in colour, pinkish inside; length 12, breadth 6 lines.

St. Vincent's Gulf (Tate, Bednall). Kangaroo Island (Tate). "Dredged along with horny zoophytes and nullipores at a depth of seven or eight fathoms" (Angas).

Tasmania (Tenison Woods).

Moreton Bay, Queensland (Strange).

Following Mr. G. F. Angas in his paper on the Marine Molluscan Fauna of South Australia, contributed to the Zoological Society in 1865, I had named my specimens of this shell and catalogued it in this paper as *M. scalaris* of Adams, but Professor Tate has not only kindly shown me the original description and figure of Quoy and Gaimard in that magnificent work the Voyage of the Astrolabe, but a very perfect and beautiful specimen obtained by him at Kangaroo Island; also a very large fossil example from the Tertiary formation of New Zealand. From the comparisons made I feel sure that there can be no doubt of the identification of the South Australian shell with *M. octogonus*. In New Zealand the species attains twice the size it does in these waters, and in the type specimen figured by Quoy the foliations on the varices are much more prominent. Mr. Tryon reproduces Quoy's figures in his Manual of Conchology, vol. ii., pl. 30, figs. 272 and 273. He also gives a representation of *M. cuspidatus*, Sow. (fig. 24), which he says is a synonym. This more nearly represents our form than the original. By rejecting the synonyms of Adams and Woods it will be seen that the shell under review is recorded from South Australia, Tasmania, New Zealand, and Queensland, but not from New South Wales; the description and figure of the *M. Brazieri* of Angas, noted above, from that part of the Australian coast, answer so closely to *M. octogonus* that there is little room to doubt that it is that species described from an immature shell.

In the Manual of Conchology before referred to Mr. Tryon has expunged the M. *scalaris* of Adams, and substituted for it the name of *M. Angasi*, adding the following remarks;—"Said to resemble *M. cristatus*, Brocchi. Possibly identical with *M. octogonus* (Quoy et Gaim). As Brocchi has used the name for a fossil species, this may be known as *M. Angasi*." There was little occasion for Mr. Tryon to rename *M. scalaris*, as

Digitized by Google

apparently he himself had small doubt of the shell being referable to *M. octogonus*; besides his work contains (only a few pages previously) the description of the *Murex Angasi* of Crosse.

M (Ocinebra) pumilus.—A. Ad.; *Pro. Zool. Soc., Lond.*, 1863, p. 70.—Shell small, fusiform, imperforate, with distinct rounded (about eight) varices extending the whole length of the shell crossed by fine transverse liræ ending abruptly on the outer lip; whorls four to five rounded; aperture oval, attenuated anteriorly, inner lip smooth; outer lip waved in answer to the exterior liræ; colour grey, but worn specimens are a delicate flesh colour both outside and in; length, 4½; breadth, 3 lines.

MacDonnell Bay, Fowler's Bay (Tate). Henley Beach, Semaphore, Aldinga (Tate, Bednall). East side St. Vincent's Gulf (Angas). Also received by me from Port Lincoln.

In some specimens the transverse liræ are more prominent than the varices, giving the shell at a superficial glance the appearance of a different species.

Both the *M. pumilus* of Kuster and *M. pumilus* of A. Adams are figured in Tryon's work, the former in pl. 36, f. 413 and the latter in pl. 38, f. 470, but neither of the figures really represents the shell which I have here described.

M. serotinus—A. Ad.; *Pro. Zool. Soc., Lond.*, 1851, p. 268.

One specimen obtained (alive) amongst the rocks at low water spring tides, Aldinga Bay (Angas). Not known to local collectors.

Mr. Tryon has been unable, from the meagreness of the original description and the absence of any figure of the shell, to place this species in any of the sub-generic groups; and in his Manual of Conchology he has included it in a list of indeterminate species. Mr. Sowerby, the same work states, affirms that the shell is synonymous with *M. Blainvillei*, Payr., a Mediterranean form.

Genus Typhis, Montfort.

Typhis Yatesi.—Crosse, *Journ. de Conch.*, vol. xiii., p. 54, pl. 2, f. 3.—"Shell imperforate, subquadrangular, elongately oval, somewhat thin, translucid, white in colour, slightly tinged with pink; whorls six, each one bearing four flexuous compressed jagged varices, terminating in a hollow sharp and recurved spine when perfect, in the spaces between the varices a prominent simple tube; canal entirely closed from the aperture to the base, somewhat large, slightly oblique and recurved. Length fourteen millimetres, greatest diameter seven. This species is easily distinguished from its congeners by the elegant denticulation of the varices."—*Crosse*.

Holdfast Bay, Semaphore, St. Vincent's Gulf (Angas, Tate, Forwood, Bednall). Stansbury (Tate). Somewhat rare.

Digitized by Google

A Few Remarks About Weather Forecasting for South Australia.

By W. Ernest Cooke, B.A., Acting Government Astronomer.

[Read Sept. 8th, 1885.]

The comparatively recent science of meteorology has advanced sufficiently far to become of considerable practical benefit to mariners, farmers, and all those whom the question whence the storm cometh and whither it goeth vitally affects. Having recognised the great strides that have lately been made, a number of persons seem to think that now it is a comparatively easy matter to forecast coming weather for one or two days ahead with absolute certainty; and, in fact, several letters and articles have appeared recently in various colonial papers taking up this view of the case, and causing many to wonder why, under the circumstances, reliable weather forecasts are not issued in the daily papers. I wish, in these remarks, to place before the Society a few considerations as to the reasons why such a desirable result cannot at present be brought about, as far as South Australian weather is concerned.

The manner in which a number of the aforementioned articles refer to this matter indicates a misconception. They liken the approach of a cyclone from the westward to the advent of a railway train whose times of passing the successive stations are duly telegraphed. It passes Albany at a given time, Esperance Bay some hours later, and Eucla a certain number of hours later still. Now we have only to make a very simple calculation in order to find out the exact time it will pass, say Adelaide. The only meteorological reports that are necessary are those from, say, Albany, Esperance Bay, and Eucla, and all within reach of a daily newspaper ought to be informed with absolute certainty of the state of the weather two or three days ahead. Yet this is not done. Why? Possibly there are one or two premises, stated or inferred, in the above argument that are to a certain extent unsound. First of all, we say a depression passes Albany at a certain time. Who is to tell that? I suppose Albany is one of the most impossible places in the world to state with any certainty that a depression has passed eastwards. The winds there seem to be almost always westerly, so they can be no guide to the direction of the central depression; and the barometer is so differently affected there from other places along the coast that

Digitized by Google

it by itself offers no sure guide. Very often Albany will report a sudden fall of half an inch in twenty-four hours, while other places will be entirely ignored by the depression. Then again suppose we are satisfied, from a concurrence of reasons, that a storm centre lies to the south of Albany, we have no guide whatever as to what its movements will be. By mapping out the whole of Australia and New Zealand with isobaric lines, as is regularly done every morning, we can perhaps infer to a certain extent that certain particular movements are unlikely. If, for instance, an anticyclonic area, or a region of high barometers, were lying over south-eastern Australia, and another over, or to the west of New Zealand, the normal winter high pressure being over central Australia, while a low pressure was noticed to the south or south-east of the Leeuwin, we would have fairly good reasons to suppose that the said low pressure would not move eastwards for a time, until some changes had taken place in the conditions over south-eastern Australia and New Zealand. But when no such decided barriers are opposed to a storm's progress, it is not always easy to say in what manner one that is supposed to be off the Leeuwin will act. Sometimes it will come steadily eastward, sometimes south-east, sometimes shoot up into the Great Bight, and after an indefinite time travel south-east, sometimes southward, sometimes remain where it is, and sometimes all trace of it will disappear during the course of a day.

The most serious difficulty with which we have to contend lies in the fact that almost all the storm centres keep well to the south of the continent. We have thus very often no sure guide as to the distance of this centre, no exact knowledge of the shape of the isobars, even on the northern quadrants, none whatever on the southern, and no idea of the state of the atmospheric pressure to the south-east, south, and south-west, to give reasonable grounds for assuming the centre will move in any given direction, or with any given velocity. When we have managed to satisfy ourselves that a disturbance lies a little south of Eucla, as a general rule we notice that the time of lowest pressure will occur at Adelaide about 20 to 24 hours later, but sometimes the minimum readings occur almost simultaneously at the two stations. There is, however, a very large percentage of storms that once fairly seen to be on their way past Eucla will reach Adelaide in from 12 to 24 hours.

Another difficulty occurs. Suppose we have noticed a storm centre pass Eucla, after having previously traced it past Albany and Esperance Bay, and have noticed that it is a perfectly steady and business-like storm, proceeding onward composedly and regularly in its work of destruction or otherwise, and we can be pretty certain that Adelaide will have a

Digitized by Google

minimum barometric pressure within the next 24 hours, and Cape Northumberland some six or twelve hours after. Even in such a case as this, it is not always positively certain that a given kind of weather will follow. There are, of course, certain rules as to the kind of weather we may expect at different parts of a storm's path. These are purely empirical, and have been collated from observations made on Australian storms since the establishment of the Western Australian telegraph. Any rules that have been previously discovered in the northern hemisphere have been found to be of no practical use for application here. We find that we must carefully investigate as far as possible our own storms, and find out empirical laws therefrom for our practical guidance. As a matter of fact, one rule seems to be pretty firmly established—that with a certain class of depressions, occurring mostly in winter, the weather is fine a long distance ahead of the coming storm; as the centre approaches the sky becomes clouded over first with cirrus, then cumulus, or rather cumulo-stratus. Light rain sets in some time before the lowest pressure, and while the wind is still light from the north; but after the lowest pressure has passed the wind veers to the S.W., the clouds change into scattered watery cumulus, nimbus, and scud; the wind blows strongly, and the rain descends in heavy showers. I think I may say that this is the usual type of winter depressions; at all events, most of those during the late winter have been of this sort. But, then, the light rain preceding the centre sometimes starts two days, sometimes only a few hours, prior to the passage of minimum pressure. Sometimes the light rain is absent, and we experience a strong northerly gale. Sometimes the weather clears almost directly after the passage of the centre, and sometimes remains showery for a week. We might think it would be very easy to tell what particular sort of weather was connected with any particular part of the movement by noting the change at the various western stations as the storm centre passed them. But suppose Albany reports fine weather almost up to the time of minimum pressure, followed by very heavy rain, Esperance Bay heavy rain followed by scattered showers, and Eucla a strong northerly gale with no rain and a veer to west or south-west with fine weather after the passage, while Streaky Bay and Port Lincoln report threatening weather, it is rather difficult to say with any degree of certainty which of these different phases will be presented as the disturbance passes Adelaide. We are never at all sure of a depression until Eucla shows indubitable signs of its presence; but when once it has passed Eucla it is almost certain to travel eastward or south-eastward, and thus for a large number of storms we have warning at least twelve hours in advance.

Digitized by Google

I think it would be premature to issue forecasts at present until we get to more thoroughly understand the behaviour of storms between Leeuwin and Eucla, and the only way to do this is by careful inspection every day of isobar maps of the entire continent, such as are displayed in the hall of the Post-office, and by carefully noting the weather accompanying certain recognised forms of disturbance. Melbourne is much more favourably situated than we for forecasting, since, as I I have pointed out, storms are to a great extent regular in their passage after passing Eucla, and thus observers at Melbourne have very often a good thirty-six hours' warning at least. Of course a number of circumstances may easily tend to render a forecast at Melbourne incorrect—such, for instance, as the case of a storm-centre off the south of Tasmania moving up or expanding northwards. This has happened on several occasions, and of course no warning of this could possibly be obtained. The cause of such a movement would probably be found far away in the Southern Ocean.

As a matter of fact, forecasts are published regularly in the *Argus* by the Victorian Government Astronomer, and, I believe, are to a very great extent trustworthy. With our present knowledge of the general laws of storms, and the behaviour of certain particular types of Australian cyclones, I believe it would be possible to issue forecasts for twenty-four hours ahead, of which a large percentage would be correct. Owing to the difficulties I have pointed out, however, the forecasts could not be absolutely depended on; but we may look forward confidently to some time in the near future when fresh discoveries and more elaborate research will enable the practical meteorologist to foretell with comparative certainty the coming climatic conditions for one, two, or three days, if not for weeks.

Digitized by Google

ONS TO THE FLORA OF EXTRA-TROPICAL H AUSTRALIA, INCLUDING DESCRIPTIONS WO NEW SPECIES.

By Professor Ralph Tate, F.G.S., F.L.S., &c.

[Read October 6, 1885.]

SPHANIA SIMULANS, *F. von. Mueller* and *Tate.*

temless or very short stems or branches from the root, set with short glandular hairs; leaves conspicuously vate-oblong, cuneate at the base, wavy at the margin short-lobed; flowers in elongated leafless, dense, kes; segments of the calyx three, somewhat scarious, prominently angular in front and at the margin, the summit, closing valvularly together over the fruit, angles membranous, not fringed; tube of the calyx papillular; stigmas two, subtle-capillary; fruit pale-brown, smooth, translucent; embryo nearly ar.

, salt-flats, Cootanoorinna, on the west side of Lake lcolm *Murray.*

ant simulates in a remarkable manner the *D. planta- v. M.*, so much so, that without careful inspection it passed for that species; but the leaves are provided der stalks and sinuated margins, the flowers are not so readily falling off in age, the bracts less de- he segments of the calyx are almost deltoid, not ot thinly attenuated, but connate into an almost ic base, which partly encloses the fruit; the latter not ovate, the raphe forming a broad dark-brown me approach of the genus *Dysphania* to the section m of *Chenopodium* is established by this species, as ticed by a close comparison of *C. atriplicinum* and ly *C. cristatum.*

MA TURGIDIFOLIA, *F. v. M.*; Frag. X., p. 83, 1876. or. *F. v. M.*, in 2nd Supplt. Census Aust. Plants.

A MITCHELLI, *Bentham.* Strzelecki Creek. *James od!*

LORANTHUS GIBBERULUS, *Tate.*

s and foliage hoary-tomentose; inflorescence woolly- Leaves alternate or nearly opposite, terete, stout, tly two inches long. Flowers axillary, pedicellate,

Digitized by Google

in pairs, or the common peduncle bearing two rays, each with two pedicellate flowers. No bracts. Calyx border deeply cup-shaped, truncate; bracteole gibbous adnate to the calyx tube. Petals four free, narrow, woolly externally, glabrous and dark red interiorly, one to one and a half inch long, dilated apex of bud tetragonal. Anthers adnate, oblong linear. Style filiform, nearly as long as the corolla. Fruit not seen.

Parasitic on *Grevillea nematophylla*, which is restricted to the "gypsum rises" of the William Tableland, Lake Eyre basin, west. *Malcolm Murray*. Flowering in April.

This new species has a general agreement with *L. linophyllus*, and especially with *forma c.* (*Bentham*), having woolly-tomentose flowers, but it differs by its cup-shaped calyx border, stouter habit, tomentose investiture, and by the gibbous base of the calyx-tube. It resembles *L. Quandang* by its investiture, but the leaves, calyx, and pedicellate flowers are different.

STYPHELIA (LEUCOPOGON) COSTATA, *F. v. M.*, in Southern Science Record, April, 1885. *S. striata, Tate*, Trans. Roy. Soc., South Australia, vol. VI., p. 166 (*non.*, *Sprengel*). Kangaroo Island.

STYPHELIA (LEUCOPOGON) STRIATA, *Sprengel*. Eucla (*teste, F. v. M.*)

XANTHORRHÆA TATEANA, *F. v. M.* *X. quadrangulata, Tate*, Trans. Roy. Soc. South Aust., vol. VI., p. 168 (*non.*, *F. v. M.*). Kangaroo Island. Probably Mount Crawford Swamps, near Williamstown; and the Black Swamp, District of Encounter Bay.

Digitized by Google

E Persistency of Electric Currents in Masses of Iron.

Cause of the Luminosity of Flame.

By Prof. H. Lamb, M.A.

wing abstracts form the substance of some remarks, l by experiments, delivered by Prof. Lamb before the the evening of March 3, 1885, *with supplementary Prof. Rennie:—*

he Persistency of Electric Currents in Masses of Iron.

Lamb showed some experiments illustrating the ay of electric currents circulating in a cylindrical n, and subject only to their mutual induction. A n two inches in diameter was surrounded by two pper wire, which may conveniently be called the d the secondary coil. A steady current from a nade to circulate round the primary coil, and so he iron bar. This circuit being suddenly broken, e induced in the bar, which tend to maintain its The decay of these currents and of the accom- agnetism produces a gradually diminishing electro- e of induction in the secondary coil, which is in n a sensitive mirror galvanometer. The intensity of -motive force at any instant after the break of the y be estimated by closing the secondary circuit, viously open, and observing the first swing of the er needle. The breaks and makes were made by n Attwood's machine, and the interval between the the primary and the "make" of the secondary could In the actual experiments this interval was increased e steps of ·15 of a second. In this way the gradual e currents in the iron can be traced without diffi- er 1½ seconds from the time of the original break. o theory the persistency of the currents is propor- e square of the diameter of the bar, so that for an er a foot in diameter the corresponding interval of be about a minute. Some account of the above s was given to the Society nearly two years ago, but nents have recently been repeated with various nts in the method of observation, and the author

Digitized by Google

hoped soon to be able to lay the final results before the Society.

On the Cause of the Luminosity of Flame.

Professor Lamb called attention to a very interesting discussion which had recently taken place on the above subject in Germany. Luminous flames are of two kinds. In the first kind—for example the upper part of the flame of a candle or of an ordinary gas flame—we have an intense white light, caused, as is generally held, by particles of solid carbon shining in virtue of their high temperature, just as an iron bar becomes white hot if its temperature be sufficiently raised. It is fair to mention, however, that this explanation has been called in question, but the balance of evidence seems on the whole decidedly in its favour. The discussion to which Prof. Lamb wished to call attention had reference to the second class of flames, where we have a gas shining with a light (generally faint) of its own, and containing no solid particles. An instance is the flame of a Bunsen's burner well supplied with air. It is generally supposed that this light is simply due to the fact that the gas is at a high temperature; that in the chemical processes of combustion a certain amount of heat is set free, which has the effect of raising the temperature of the gas; and that the luminosity is a secondary effect due to the rise of temperature. This view has been recently called in question by W. Siemens, of Berlin, who finds that air and some other gases may be raised to a temperature considerably above that of the Bunsen flame without becoming in any degree luminous. The observations were made at night on the air, &c., contained in an oven, used in the manufacture of hard glass, the walls of which could be raised to a temperature above that of melting steel. The line of vision passed through two opposite apertures in the walls, and care was taken, by arranging suitable screens, that no light from the walls themselves should reach the eye. Siemens suggests that the light of the Bunsen flame is a direct result of the chemical changes which are going on, and has nothing to do with the temperature of the gas. It is, in fact, conceivable that the violent tearing asunder of the molecules and the rearrangement of their constituents in other combinations may give rise to disturbances in the luminiferous ether. This explanation is supported by the fact that if care be taken to secure a more intimate mixture of the air and other gases before combustion the flame becomes shorter, although much hotter, the chemical processes being completed within a shorter distance from the nozzle. If the light were the result of the temperature, then the flame ought to become longer instead of shorter, for the

Digitized by Google

move away further from the nozzle before cooling
views of Siemens are supported by the observa-
. Wiedemann and of Hittorf on the passage of
hrough rarefied gases. E. Wiedemann has found,
neasurement of the heat developed that a gas may
inous under the influence of an electric discharge
mperature is considerably under the boiling point
Hittorf, by means of a powerful bichromate
2,400 cells, obtained an apparently continuous
ugh a glass tube containing rarefied gas. On some
ie gas was luminous whilst the tube was not too
touched by the hand without inconvenience. This
, quite inconsistent with a high temperature of the
other experiment the current was led by iridium
to a tube, and a dark space was observed round the
minal. This terminal became so hot that the metal
owing with an intense white light, whilst the gas
in contact with it (and therefore at a very high
) was quite dark. We have, then, very strong
at gases can become luminous under the influence
processes, independently of a rise of temperature;
ring the very close relations between electrical and
ions, it is not surprising that the same should be
nical processes, such as we meet with in combus-

Rennie then made some remarks on the cause of
ity of the first class of flames mentioned by Pro-
b:—The usually accepted theory regarding the
of an ordinary candle or gas flame is that it is due
ence of solid particles of carbon at a white heat.
ago Professor Frankland made some experiments
hought disproved this theory. He showed that
t can be produced under conditions which, as he
cluded the possible presence of any solid particles
le, arsenic burning in oxygen. In this case it is
e temperature of the flame is such that the arsenic
ie products of its combustion must be in a state of
e showed also that certain non-luminous flames
inous under increased pressure. He ascribed the
of ordinary flames therefore to the presence of very
carbons at a very high temperature. He was con-
is belief by the transparency of such flames and by
t the soot deposited on cold substances placed in
was not pure carbon, but contained hydrogen.
kland's experiments were made other scientists,
ermany, have investigated the subject, with the
the original theory has been confirmed for the

Digitized by Google

following reasons:—1. Ordinary flames cast a shadow in sunlight, and it is difficult to believe that this can happen except by the intervention of solid particles; and carbon is the only solid substance which can be present. 2. Flames artificially made to contain solid particles have been shown to be as transparent as an ordinary gas flame. 3. If there be only heated vapour in such a flame, soot ought not to be deposited on a strongly heated rod held in it, whereas, as a matter of fact, soot is deposited under such conditions. 4. By causing one flame to meet another the particles of carbon may be made as it were to agglomerate, and a much coarser-grained soot is obtained. 5. The quantity of hydrogen in soot is extremely small, very much less than in the densest hydrocarbons. The small luminosity of a Bunsen flame has been usually ascribed to the complete combustion of the solid particles of carbon, but it has been shown that the previous admixture of nitrogen and other inert gases with the coal gas renders the flame almost non-luminous. This is probably due to the lowering of temperature produced by the admixture of a large volume of inactive gas, for the luminosity can be restored by heating the mixture before burning. In a Bunsen flame the added heat due to increased combustion probably overbalances the cooling effect of the admixture of air. That the heating of gas before it reaches the burner greatly increases the illuminating power is well known, and this principle has been applied practically in recent improvements in gas-lighting in England and Europe.

Digitized by Google

THE APRICOT DISEASE.

By F. S. CRAWFORD.

[Read November 4, 1884.]

Two years ago I forwarded to Dr. M. C. Cooke leaves and fruit of the apricot—the former attacked with the "Shot-hole Fungus," and the latter with the pustular disease on the fruit, both which have been so common of late. I likewise mentioned that I thought there was a relationship between the two fungi. In reply Dr. Cooke stated that the shot-hole fungus was *Phyllosticta circumcissa*, and the pustular disease was caused by *Helminthosporium rhabdiferum*, and that the two fungi were entirely distinct.

Observations made during the last and present seasons have strengthened my suspicions that the two fungi are connected, and this opinion has been confirmed during the last few days by discovering several specimens of the shot-hole fungus on almond leaves in a state of fruit, the spores of which are precisely similar to those of the apricot fruit fungus, and which in shape resemble an *Helminthosporium*, and not a *Phyllosticta*.

In spite of the prevalence of the shot-hole fungus on the almond, cherry, plum, apricot, &c., it is a rare thing to find it showing spores. One day I discovered several spots on an almond leaf abounding with spores, but the next day failed to find any after a prolonged search, although to the naked eye the spots seemed precisely similar, and the leaves were taken from the same part of the tree. This may be owing to either the fruit spores growing very rapidly, and as quickly falling off, or else that a spore falling on a leaf gives rise to a mycelium, which grows, making the characteristic brown spot that soon drops from the leaf, but which only under exceptional circumstances produces spores in that stage of its existence.

In looking over Dr. Cooke's letters I am inclined to think that in naming the shot-hole fungus a *Phyllosticta* an error was accidentally made, because several other fungi were forwarded at the same time, and it was quite possible that one was a *Phyllosticta*; and as *P. circumcissa*, according to Cooke, makes shot-holes in the leaves of many plants, the mistake might thus easily arise. I also wish to point out that *Helminthosporium rhabdiferum*, according to "British Fungi," is found on ripe peaches, whereas I have never seen a peach, ripe or unripe, attacked with the "pustular eruption," although the leaves are to a slight extent affected with the "shot-hole"

Digitized by Google

fungus. I am, therefore, inclined to think that this disease i not the true *H. rhabdiferum* but an undescribed, species of *Hel minthosporium*.

From an economic point, the fact of the shot-hole fungu and the apricot disease being the same is of importance. A the disease appears first on the leaves before attacking th fruit, it shows the necessity of combating the disease in thi early stage, as well as not allowing comparatively valueles trees that are diseased to remain near young and healthy one

The following is the description of the spores of the shot hole fungus:—Obovate or sub-fusiform, ·0014 inch long b ·00056 inch broad in centre; a single spore at extremity of short peduncle from which it readily parts; of a very pal greenish-brown colour, almost hyaline; mostly tri-septate many bi-septate, and a few 4-5 septate.

[December, 1885.—I take advantage of the proof of the abov being forwarded for correction to add a few remarks. I found that during last winter, before all the almond leaves had fallen that in the centre of the roundish-brown spots were generall to be found one or more tufts of a light brown colour, abou $\frac{1}{120}$ inch in diameter, and which consisted of a great number o these spores growing on their peduncles. In early summe these tufts no longer appeared, although the brown discoloure spots became more numerous, which soon falling out forme the characteristic shot-holes. As soon as the fruit of the apri cot begins to form, one or more very minute specks may b observed, but always on the upper side of the fruit; thes specks increase in number and size until they make the brow scabs or "pustular eruptions." The scabby fruit is alway most prevalent on trees that are most attacked with the shot hole fungus, and always worse where the leaves are thickes over the fruit. Mr. Tepper informs me that Professor Lud wig, of Germany, had decided, from some almond leaves he ha sent him, that they were attacked with *Sporidesmium amygda learum*, but as Mr. Tepper is doubtful whether the Professo saw any spores, and as he was not aware of the supposed con nection of the shot-hole fungus with the "pustular eruption on the apricot, and as, moreover, the spores above-mentioned do not answer the description of a *Sporidesmium*, I am still o opinion that it is a true *Helminthosporium*.—F.S.C.]

Digitized by Google

Fossil Foraminifera from the rnment Boring at Hergott Town- with General Remarks on the on and on other forms of Microzoa ved therein.

By Walter Howchin, F.G.S.

[Read December 2, 1884.]

ime ago a small quantity of material obtained from ment boring at Hergott was placed in my hands r Tate to examine in the hope that a careful search l some forms of microzoa by which, at least, the acter or otherwise of the beds through which the carried might be determined. Mr. Clement L. o whom Professor Tate was indebted for these indly added to their quantity. I am also placed t obligation to Mr. Jas. W. Jones, the Conservator for his ready courtesy and liberality in placing les of the core at my disposal. By this means enabled to test the microscopic contents of this section throughout its entire depth. The figures f the various depths from which the samples were gret to say, are rather vague, but are the best in- s to their respective geological horizons which was sal; but this is of less consequence on account of uniformity of the beds through which the bore

also acknowledge my indebtedness to the great y friend Mr. Henry Bowman Brady, F.R.S., on inifera of the Challenger Expedition, which has published by the British Government. When we account the great number of new species therein described, the fulness of information on this par- l of zoological investigation which it supplies, and cts as to the distribution and bathymetrical range rine Rhizopoda, which are now for the first time c, the work must rank as one of the most important ns to the history of the Foraminifera that has ever shed. Mr. Brady has found it necessary, in working rmous quantity of new material which was placed ds, to rearrange some groups, and this necessitated ge in the nomenclature. I have in the following dopted Mr. Brady's classification, which will un-

Digitized by Google

doubtedly be generally accepted by workers in this department of natural history.

Nine samples of material were washed and searched, in all, from the Hergott bore, on which the following remarks may be made:—

Remarks on the Section.

1. *Surface Bed.*—The surface, according to a sample submitted to me by Mr. Wragge, is a bed of loose sand, reddish in hue, and passing from very fine particles up to a shingle of small pebbles. The fragments are mostly quartz, and are for the most part rounded by attrition. The quartz presents the features of the transparent and milky varieties, and are often stained with iron. One or two organic remains were found in this sample when placed under examination. One of these was the single valve of a very minute bivalve shell, much weathered; also a small concave and hemispherical body, finely foraminated on its convex side; and in addition to these a few arenaceous tubular objects, the zoological character of which it is very difficult to determine. The lithological features of this surface bed are so widely different from the underlying that it evidently represents a totally different condition of things in its deposition. It may be after all only an alluvial wash with a few organic remains mixed with the gravel, these having been derived from older beds. It would be interesting to know the exact thickness of this surface bed, and whether its parting from the underlying great silt bed is a sharply-defined line, or whether the finer silt of the lower passes gradually into the coarser beds that overlie it. The next sample, which is marked as only fifteen feet in depth, shows the passage from the one to the other at that depth to be complete.

2. *Fifteen feet from surface.*—A very fine argillaceous silt with a small proportion of mica. Has a compact appearance in its natural state, but goes down easily in water, and then swells out to several times its former bulk. The residuum left after washing the material and running off the light flocculent particles, is exceedingly small, and is reduced to about one-twentieth of its original weight. Although no signs of organic remains could be detected in the mass before treatment, the results obtained after washing the material were very interesting. There are few objects of an organic nature present in this sample except Foraminifera, a single Entomostracan carapace and a trace of vegetable tissues making up the number. The Foraminifera are represented by ten species, one of which, *Pulvinulina elegans*, d'Orb., has only been found in the section at this depth, and there but a single specimen; the rest are all arenaceous forms.

Digitized by Google

3. *Twenty to forty feet from surface.*—The stratigraphical and lithological features of this sample correspond almost exactly with the preceding, having, perhaps, a slightly larger proportion of micaceous particles. Residuum very small in quantity. Under the glass this is shown to consist mainly of small flakes of the matrix not dissolved by the washing, and a considerable number of fragments made up of very minute crystalline particles. The majority of these are apparently aggregations of crystals; but scattered amongst the material are a few objects somewhat similar in appearance to these crystalline bodies, because built up of like particles, but of organic origin. These coarsely-arenaceous Foraminifera, of which there are seven species recorded from this washing, make up nearly the whole of the fossil contents from this depth. The remainder consist of one or two very minute fragments of carbonaceous matter and a few other fragmentary objects, probably of organic origin, but too imperfect to show their zoological relationships.

4. *Forty to fifty feet from surface.*—The general features of this sample resemble very closely the preceding, being evidently a continuation of the same bed of argillaceous silt. Seven species of Foraminifera occur, none of which are peculiar to the geological horizon. This sample is, however, of some interest in supplying a single valve of *Lingula* and two other fragments, which appear to belong to the same species. It is so small a shell as to require a magnifying glass to determine its character. The only other objects worty of note are a detached cell of a polyzoan (the only indication of polyzoanal life found in the entire section), small fragments of drift-wood, a (?) seed case, and a few pyritous casts which are globular or cylindrical in shape, the latter are straight, serpentine, and rarely bifurcating.

5. *Fifty to fifty-five feet from surface.*—Lithological character similar to preceding. The amount of material operated upon from this depth was very small, but moderately rich in its foraminiferal contents. These latter belong to eleven species under seven genera. A trace of molluscan remains was observed in the form of one or two small shell fragments; also one Entomostracan, several seed or egg cases of a brown colour, and small fragments of vegetable matter.

6. *One hundred to two hundred feet from the surface.*—The material from this depth placed at my disposal consisted entirely of the casts of a molluscan bivalve, about the size of a cockle shell. One or two of the least perfect of these casts were dissolved in water, and these left a rather larger proportion of residuum than usual in these washings, in consequence

Digitized by Google

of the somewhat stronger character of the matrix. This less degree of solubility appears to be owing simply to the distribution of small crystals of iron pyrites scattered through the mass and binding it together. The amount of material thus searched was very small, yet it proved to be the richest sample in its palæontological contents of the whole section. The Foraminifera number thirteen species, in no less than nine genera. Two genera are peculiar to this particular geological horizon—*Verneuilina polystropha* and *(?) Endothyra Bowmani*, the latter a characteristic Carboniferous form, of which we shall say more presently. The associated remains consist of fish bones, including several split vertebræ, a highly decorated Entomostracan, comminuted shells of mollusca, and some vegetable matter.

7. *Two hundred feet from surface.*—A separate sample thus labelled was supplied to me by Mr. Jones. This contains but three species of Foraminifera, but of these *Cristellaria rotulata* is peculiar to this washing, and it is also the best horizon for *Marginulina*. Next to the Foraminifera the most interesting feature of this material is in the occurrences of several fragments of *Dentalium*, a gasteropodous mollusc which has a wide range in geological time. There are also indications of bivalves, fish bones, and a few small cylindrical casts. [Three additional species have since been determined from this depth from mountings submitted to me by Mr. G. Goyder, jun.]

8. *One hundred to three hundred feet.*—The great silt bed appears to be little altered in character even at this depth. The fossil contents are few and weathered. Only three species of Foraminifera were noted. One of these—*Marginulina*—appears to be limited to about this depth, as it was only noted in this and the preceding sample. A few molluscan fragments also occur.

9. *Three hundred and four feet to three hundred and six feet from surface.*—In this washing a marked change in the stratigraphical character of the bed is apparent. The matrix is still a fine argillaceous silt, but it is studded with a large number of small stones and pebbles, mixed with quartz and a green mineral, which is probably glauconite. The enclosed pieces of rock are much water-worn, and indicate a littoral deposit formed in close proximity to land. In consequence of the large proportion of insoluble material in the rock stuff, the residuum left from washing was much greater than in the previous samples. Organic remains at this depth are very scarce, but the relatively greater proportion of residuum may partly account for this apparent scarcity of organic remains. The Foraminifera are represented by only four species, and

Digitized by Google

these were for the most part single examples of their kind. In addition to some irony-looking casts there occur a few fragments which carry the lustre and colour commonly seen in fossil bone. An examination by sections of a considerable number of specimens of this kind, in this and the following sample of material, has led me to conclude that they are shell remains of an unusual colour. Some of the fragments appear as though they had been perforated by some boring annelid. There was also found in this sample a fragment which belongs probably to the calcareous algæ.

10. *From three hundred and six feet to three hundred and nine feet from surface.*—This, like the preceding, is evidently a littoral deposit, and the two samples must be stratigraphically associated. When examined under a lens it is seen to be made up almost entirely of a fine-grained sandstone that has been broken down by some denuding forces and subjected to attrition. The sand grains are for the most part very small, and have evidently been derived from a soft sandstone that formed the shore line. Some of the fragments of rock enclosed in this bed are white and others of a greenish hue, the latter being in sufficient quantities to give a decided greenish cast to the bed. The organic remains are few. The most numerous of these consist of the smooth and polished objects referred to in the preceding sample, and these show evidences of wave action in their abraded edges. Only two species of Foraminifera occur, but one of these, *Placopsilina cenomana*, d'Orb., is peculiar to this sample, and forms an interesting addition to the list.

Remarks on the Species.

Hyperammina vagans, Brady.—This is an arenaceous Foraminifer, possessing an undivided and unbranched tube which follows most tortuous lines, being often coiled on itself, not unlike some marine annelid growths. It possesses a primordial chamber of a round or oval shape, which is inflated and slightly larger than the tubular extension. In the Hergott material there is one example of the tube coiled and two examples of the primordial chamber which are of an oval shape. The collection made by the Challenger shows that this species has an almost universal distribution in the seas of the present day—from Spitzbergen to Kerguelen Island. It seems to prefer a cold habitat, as in the Arctic seas it comes within fifteen fathoms of the surface, whilst in the great ocean depths it was dredged from a depth of 2,900 fathoms, where a similar Arctic climate prevails. This form has been recently found in the Jurassic rocks of Switzerland by Dr. R. Haeusler, and has been described and figured by him in the "Quarterly Journal of the Geological Society" (Feb. 1, 1883). There is also a

Digitized by Google

strong probability this this species occurs as a Silurian fossil as Messrs. Nicholson and Etheridge, in their monograph on the Silurian fossils of Girvan, in Ayrshire, have described a tubular organism which Mr. Brady considers to be none other than the species now under consideration. Its simple structure gives probability to its being an archæan type, and the wide distribution of the form at the present day shows it to be capable of a ready adaptation to varying conditions. Its obscure character and close resemblance to other zoological types may be the reason why it has been completely overlooked as a geological species until recently.

(?) Thurammina papillata, Brady.—*Thurammina* is a new genus founded by Mr. H. B. Brady to include some single chambered and arenaceous Foraminifera which usually show more or less perforated papillæ on their exterior surfaces. This species is often spherical, but is subject to great variation in outline. In the Hergott material there are a few spherical and arenaceous Foraminifera which we have referred to this genus. The papillæ are not very well defined in the examples I have obtained, but they show a pimpled surface suggestive of papillæ. Their less perfect appearance may be caused by the compression to which these, as well as nearly all the species from Hergott, have been subject. More perfect specimens might indicate that these forms belong to some closely-allied genus, but for the present they may be classed with some reserve as above. *Thurammina papillata*, like *Hyperammina vagans*, is a denizen of all seas at the present day where deep water occurs, but is not often found at less depths than 500 fathoms. Dr. Haeusler found this species associated with *Hyperammina vagans* in the Jurassic rocks of Switzerland already referred to, and it is rather curious that a similar assumed companionship in these two genera should have occurred in the case of South Australian palæontology.

Reophax scorpiurus, Montfort.—The genus *Reophax*, as now defined by Mr. Brady, includes all the free, non-spiral, and non-labyrinthic *Lituolæ*. The general characters of the genus are a coarsely arenaceous test, with a single inflated chamber or a number of such chambers strung together in a series, which may be either straight or crooked. *Reophax scorpiurus* is so named from its supposed likeness to a scorpion, having a tapering and often upturned end. It is represented in the Hergott material at three distinct horizons, all under 200 feet. It is by no means a common form in any of the washings, being more generally represented by its starved variety, *R. fusiformis*, to be referred to presently. In existing seas *R. scorpiurus* is widely distributed, and generally pretty common where it occurs. It has an equally wide bathymetrical range, and seem

Digitized by Google

at home in either hot or cold areas. It has been noted from the shallows down to 4,000 fathoms. As a fossil it occurs in the Oolite of France, Jurassic of Switzerland, and Post-Tertiary of Norway.

Reophax fusiformis, Williamson.—This is a one-chambered variety of *R. scorpiurus*, and represents uncongenial and shallow-water conditions. It is the commonest species of the foraminiferal fauna in the Hergott section. This is an interesting fact when considered in relation to its known range and distribution. It is not a common form in the present day. It has been taken in the North Atlantic and sparingly off the British coasts. To these localities the Challenger only adds a single one, off the Phillippine Islands, at 95 fathoms, whilst the species has not been previously known to occur in a fossil condition. It was not found in the Hergott material at a greater depth than 200 feet.

Reophax ampullacea, Brady.—This is a flattened variety of *R. difflugiformis*, Brady. Circular at the base, and tapering at the distal end; much compressed. One or two examples which appear to belong to this variety were found in the Hergott material, but it is much rarer than its allied species. The species was founded on Challenger specimens, and these taken at only one station, off Kerguelen Island, in 120 fathoms.

Haplophragmium agglutinans, d'Orb. — This is a coarsely arenaceous crosier-shaped form that can be easily distinguished. It occurs in moderate numbers in the upper portions of the Hergott section. It varies considerably in size, and is built up of very coarse grains of sand. The linear portion is often absent in these specimens from Hergott, probably through being broken off either beforehand or by the attrition caused by the washing. The septal lines are also obscure in these specimens, arising from the very coarse texture of the test; and the rectilineal portion, instead of gradually enlarging towards its extremity, as is generally the case, sometimes tapers to a point. *H. agglutinans* is to be found in all seas at the present day, and although it is sometimes taken in shallow waters, Mr. Brady says it is essentially a deep-sea species, from 500 to over 3,000 fathoms. I have taken it, however, in about two feet of water in the Port Creek. It is known as a Liassic, Lower Tertiary, and Miocene fossil.

Haplophragmium agglutinans, var. *rectum*, Brady. — This variety was named by Mr. H. B. Brady some years ago from a few specimens found in the Lower Carboniferous rocks of Yorkshire. It is a delicate variety, with a very small spiral-line development in comparison with the length of the linear portion. This variety passes into the typical species by every

Digitized by Google

intermediate gradation, and on this account Mr. Brady has, in his work just published, made *H. rectum* a synonym of *H. agglutinans*. But I think the name may be very well retained as a varietal distinction. In the material now under review they assume very distinct appearances without any intermediate forms that I have observed.

Haplophragmium (?) Canariense, d'Orb.—There are a few small nautiloid examples of *Haplophragmium* in most of the samples from Hergot, but they are in all cases very badly preserved, having been subject to much compression and consequent distortion. In some instances the pressure has been applied laterally, by which the two sides of the shell have been crushed together, and in others the pressure has operated on their peripheral margins, so as to reduce them to an oblong shape. In consequence of such distortion the determination of these minute species is a matter of some difficulty, and has been impossible in the short time and meagre material at my disposal. Some of the best preserved specimens show a resemblance to *H. canariense*, to which I have for the time being relegated them; but it is probable that with better specimens at command it will be found that there are more than one species brought under this determination. Dr. Stache, of Vienna, has figured two species of *Haplophragmium* from the Tertiaries of New Zealand, and it is not unlikely that the examples in Hergott material may possess specific relationship to these. *H. canariense* is of world-wide distribution although, unlike *H. agglutinans*, it is a characteristic shallow water species. It has not been hitherto known as fossil in rocks earlier than the Pleistocene.

Haplophragmium, sp.—Two examples of what appear to be an undescribed form of this genus were found, one at a depth of about 45 feet and the other at about 200 feet. They consist of a single whorl of large inflated chambers, few in numbers and in consequence of the large chambers making a sharp turn in the convolution, the septal lines are at very different angles with regard to each other. These await further elucidation.

(*?*) *Nodosinella*, sp.—There are a few straight or slightly curved nodosariform Foraminifera in the material which have been provisionally referred to this genus. The test is rough, apparently finely arenaceous, septation often obscure. None of the examples appear to be in a perfect condition, and their general features seem to indicate a closer relationship to the Carboniferous genus above quoted rather than any other of the Nodosariform group. Nodosinella has not been known hitherto outside of the Carboniferous formation, in which some of its specific forms are widely distributed. Better specimens

Digitized by Google

may show these Hergott forms to belong to something else, but for the time being we cannot give them a better classification.

(?) *Endothyra Bowmani*, Phillips.—A few examples of a Rotaliform Foraminifer occur at a depth of something under 200 feet that seem undistinguishable from *Endothyra Bowmani*. The *Endothyræ* have been so far only known as a Carboniferous type, and the particular species now referred to may be considered the most characteristic of all the Carboniferous Foraminifera. Its occurrence, therefore, in another geological formation, and one presumably of a much later age, is a point of great interest. In size the examples obtained from Hergott are smaller than the average Carboniferous specimens, but they show a close morphological resemblance to the Palæozoic forms. The same is true of the structure of the test, which in the *Endothyræ* generally is a very fine sub-arenaceous investment. From examination of the Carboniferous specimens Mr. Brady concluded the test to be imperforate, and a careful examination of several transparent sections taken of the Hergott specimens confirms this view, as no perforation of the test walls could be determined. All the examples taken of this interesting species in the Hergott material were obtained by washing down the rough casts of bivalves, already referred to, and indeed the rich gathering of Foraminifera obtained at this depth were all such as had been drifted with the mud into the shells of these molluscs, as they were rendered empty by the death of the shell-fish. Whether these shells afforded the necessary protection against pressure or not I cannot say, but the Foraminifera obtained from their casts were free from that distortion which is so common in the rest of the section.*

Bigenerina.—This is a dimorphous Foraminifer, being Textularian in its earlier growth and Nodosarian in the later chambers. It is one of the most characteristic and interesting of the Hergott forms. The genus is present in the material in two species, *B. nodosaria* and *B. digitata*. The examples might rather, in most cases, be considered as intermediate to these two forms. For the most part *B. nodosaria* approaches *B. digitata* in a more uniform outline, with a

*I have since sent all my mounts of this form, together with the transparent sections, to Mr. H. B. Brady, for his opinion regarding them, and in a letter bearing date of October 15th, 1885, he states:—"Had I found them in beds of Carboniferous age I should certainly have assigned them, as you have done, to *Endothyra Bowmani*, and this under most circumstances should be final. Nevertheless, I cannot speak with positiveness. The surface of the test appears to me granular and corroded rather than really arenaceous. On the other hand I cannot obtain any satisfactory evidence of perforation. Provisionally I should be inclined to assign them to *Endothyra Bowmani*, with some reservation in favour of *Planorbulina* (*Anomalina*) *ammonoides*, or one of the allied Secondary forms."

Digitized by Google

blunter and more obtuse point than is usual in typical examples; whilst, on the other hand, *B. digitata*, in the Hergott material, is often of the same colour as *B. nodosaria*, and approaches more nearly that species in outline.*

The genus *Bigenerina* is a very ancient one, if Mr. Brady's Carboniferous species, *B. patula*, belongs to this genus. Dr. Dawson has also figured what appears to be the same species from the Laurentian of Canada, and is there associated with the much-disputed *Eozoon Canadense*. The genus is not met with in the Secondary rocks, and the two species to which the Hergott examples are referred make their first appearance, so far as hitherto known, *B. nodosaria* in the Miocene of Vienna and Malta, and *B. digitata* in the later Tertiaries of Italy. The distribution of these species in existing seas is somewhat restricted. *B. nodosaria* is common in the North Atlantic, where it occupies shallow water; it is much rarer in the Mediterranean and North Pacific, but in the southern hemisphere Mr. Brady describes it as "exceedingly rare," being only found at one point in the South Atlantic. *B. digitata* is only known as a European form. The examples in the Hergott beds would imply that these species have had a much wider range in geological times than exists at the present day. Two examples, unfortunately broken, of a much coarser and more robust species of *Bigenerina* were found in one sample of material from Hergott, but these are too imperfect specimens to be dealt with at present.

Gaudryina pupoides, d'Orb.—The genus *Gaudryina* comprehends another dimorphous form of the Foraminifera, in which the earlier chambers follow a triserial arrangement and then pass in their later growth into a biserial order. Its geological history begins with the Cretaceous period, and it is found in most later formations to the present day. The examples from Hergott belong to two species. The most characteristic and plentiful of these species, we have referred to *G. pupoides*, as it possesses in common with that species large and inflated chambers towards the oral extremity, whilst it tapers rapidly towards the primordial end, is finely arenaceous in texture, and possesses a projecting terminal orifice similar to *G. siphonella*. These examples are all more or less flattened, which renders determination the more difficult, but they can very well be classed with *G. pupoides* until better specimens are found to disprove this relationship. In existing seas this species is common in deep water, and occurs in the Challenger gatherings from all parts of the world. It is known as far

* I have more recently obtained very characteristic examples of *B. digitata* from the Tarkaninna Bore, which is in the same geological formation.

Digitized by Google

back as the Gault, and is most common as a Cretaceous fossil. A single example of this genus was found at a depth of forty-five feet which is both longer and more tapering than those just described, but whether this is simply an individual departure from the typical form or is a member of another species cannot be determined on the evidence of a single example.

Gaudryina (?) scabra, Brady.—This is one of the new species which Mr. Brady has figured from the Challenger dredgings. It has an elongated tapering test, the oral end being broad and rounded, with the opposite extremity obtusely pointed. The triserial portion of the shell forms but a very small proportion of the whole. The aperture is an arched fissure at the inner margin of the last segment. It is rather coarsely arenaceous, and of a brownish colour. This species was taken at only two of the Challenger's stations, and these near together, off Sombrero and Culebra Islands, at depths of 450 fathoms and 390 fathoms respectively. It occurs both in the upper and lower portions of the Hergott section. It apparently agrees closely with Mr. Brady's figures and description of the species, even to the brown colour of the test, of which it shows some trace; but as the examples taken are very limited in number, I have chosen to refer this species as above with some reservation.

Verneuilina polystropha, Reuss.—This is a triserial Foraminifer, with very distinct globose chambers, and is coarsely arenaceous. It is a shallow-water species, seldom being found at a greater depth than 50 fathoms, and has its habitat on muddy bottoms and in estuaries. It is most common in the North Atlantic and Mediterranean, but it has also been found on the coast of Ceylon and on the east coast of Australia. In geological formations it is only known as a Post-Tertiary Foraminifer. Only one example was obtained from the Hergott material, at a depth of 200 feet., but this was perfectly characteristic of the species.

Placopsilina cenomana, d'Orb.—This is a very simple, tubular, and parasitic Foraminifer, often spiralline in the earlier portion, and soon becoming very irregular in growth. It is a parasitic form, and is often found growing on the surface of shells, corals, &c. It is not a very common form at the present day. It is recorded from one of the stations dredged by the Porcupine in the North Atlantic. It is also known as a Mediterranean species, and the Challenger record gives the additional localities of the South Atlantic and the coral reefs of the Pacific. Its home appears to be in the shallow waters of the tropical seas. Two or three examples which may be referred to this species were found in the Hergott material, but all these are from one horizon—and this the lowest of the section

Digitized by Google

—at 306 feet depth. As it is an adherent form, the absence of objects from the fine silt of the upper portions of the section, which are necessary for the preservation of this form, may account for its absence in the higher horizons. The examples found are attached to fragments of shell or small flakes of shale, but in none of these is the spiralline form apparent. Its geological history dates from the Lower Lias of France; it is also found in the Lias of France and England, and the Lower Oolite and Cretaceous rocks of Europe, but has not been found in any of the Tertiaries.

Lingulina carinata, d'Orb.—The genus *Lingulina* represents simply a compressed and straight *Nodosaria*. The genus is scarce in the seas of the present day, except in the tropical and subtropical portions of the Atlantic. It is known to exist as far back as the Lias, but it appears to have been always a form possessing but a limited distribution. *L. carinata* is the only species of the genus that occurs in the Hergott section, and but two examples were found. They agree with the figures usually given of this species, but one of the examples obtained has a peculiar inflation of the last segment, which is both larger and rounder than the earlier chambers, and approaches very closely to the Nodosarian character.

Cristellaria rotulata, Lamk.—Two or three fragments apparently belonging to this species have been found at Hergott. No perfect examples have been procured, but by comparing the much-weathered fragments one with another it seems moderately certain that the above is the species to which they belong. This is perhaps the most widely distributed of all the Foraminifera, both as to geographical limits and bathymetrical range, as well as geological time. It is recorded as belonging to almost all geological formations from the Upper Trias of Derbyshire downwards.

Cristellaria gibba, d'Orb.—This is a variation of *C. rotulata* in the direction of *C. crepidula*. That is, the oral extremity is drawn out so as to give an oblong shape to the shell, which is compressed. There are often found a complete series of forms from the almost circular *C. rotulata* to the extremely drawn out *C. crepidula*, with every shade of intermediate modification. D'Orbigny's *C. gibba* stands for the intermediate stage when the crepidulate tendency has been arrested. Its distribution is confounded with allied varieties. Mr. Brady notes its occurrence in North Atlantic and South Pacific at less than 500 fathoms. Its geological range has hitherto dated from the Cretaceous downwards. The examples in the bore material are few, but characteristic.

Marginulina glabra, d'Orb.—This genus unites the Cristellarian and Nodosarian features, with a marginal aperture; and

Digitized by Google

t of being slightly compressed has an oval transverse
M. glabra has a wide range as to depth in the pre-
and is very generally distributed. It is as old as
Lias, and frequently occurs in geological formations
date. It is rare in the Hergott material, and none
mples are perfect.
lina elegans, d'Orb.—There is but a single example
etty little shell recorded from Hergott. It is small
d does not show such a strongly-made test as the
ten carries, and is probably a young example. The
common in the North Atlantic and South Pacific, and
s in the Mediterranean. Its geological range dates
k as the Trias, and it is also known as a Liassic and
orm. It thrives best at moderate depths, from the
ne down to 700 fathoms.

---

ient to the reading of this paper Mr. G. Goyder, jun.,
a few micro. mounts selected from material taken
at 200 feet depth in this boring, and from which I
able to determine the three following species as ad-
those described above :—
ia radicula, Linné.—This species is the most typical
dosarinæ, has a wide distribution at the present day,
a to both shallow and deep water, and is a common
many microzoic rocks, from the Permian downwards.
rphina lactea, Walker and Jacob.—Common in most
esent day, but especially the shallows of temperate
It is not known much further south than the Cape of
pe, and is fossil in Kimmeridge Clay and later.
lina legumen, Linné.—A pod-like, slightly curved, com-
Nodosarian, widely distributed in present times, and
m Trias.

General Considerations.

tion is remarkable for the uniformity of its strati-
features. With the exception of a few feet at the
nd a few feet at the base of the section, it is practi-
one bed extending through a depth of 300 feet.
esh condition it would have appeared as a bed of
l. The homogeneous character of the sedimentary
rough so great a depth, implies that the physical con-
hich prevailed during its deposition were of a very
nd persistent kind. Not only stones, but sand also,
id to be absent from this great silt bed, as the grains
visible in most of the washings were so few as to be
appreciable. It must have been a landlocked sea or

Digitized by Google

estuary where the deposit occurred, with still water, and yet exposed to a feeble current that brought a light sediment from no very distant land, which settled down to the bottom within its quiet area. Small crystals are widely distributed throughout the mass, and a few thin beds of limestone were passed through by the drill, that show a dark colour, with spar veins running through the mass tinged with green. The limestone is calcareous, open in texture, and highly crystalline. The Hergott section rests on Primary rocks, and the last nine feet in the bore is evidently a littoral deposit giving indications of a shore line, containing pebbles of quartzite, rounded fragments of chloritic and other schists, which tell the tale of wave action on the shore as the land began to sink beneath the waters.

The section is pretty evenly fossiliferous, but the horizon at which the large bivalve casts occur, at about two hundred feet, has yielded the greatest number of forms, whilst the last nine feet at the base of the section have given the fewest. The palæontological features are restricted in range and belong almost entirely to one group of organisms. About twenty-five species of Foraminifera have been observed, and of these something like seventeen, or nearly three-fourths of the whole number, belong to the arenaceous type. This is a very unusual proportion, as the Foraminifera with calcareous and hyaline tests generally far outnumber those of an arenaceous investment. Of the well-marked species in the list only one can be considered a deep-water species; ten have their habitat in shallow water, and ten are common to both. From this analysis we may safely conclude that the sea in which these Foraminifera lived was of no great depth. It is not so easy to determine their geological age. One and perhaps four species date from Palæozoic times, thirteen are known as Secondary forms, two begin their geological history in the Tertiaries, and five have not been known previously in the fossil condition. The Foraminifera generally, as an order, are of little value in determining geological synchronism. They yield the oldest of all known existing species, and are at one and the same time the most variable and the most persistent of zoological types. The palæontological evidence outside of the Rhizopodal fauna is equally indeterminate of the age of these beds. The large bivalves, so far as I have seen them, are mere casts with a chalky coating, and the two genera that are capable of determination, viz., *Lingula* and *Dentalium*, are both common geological genera dating from early Palæozoic times. The example obtained of the former was microscopic, and of the latter broken into small fragments so as to preclude specific identification. The beds in question have been variously referred to the Jurassic and the Cretaceous periods. They are

Digitized by Google

ly Mesozoic, but there is nothing in the microzoa de-
e that throws any light upon their exact geological age.

TABLE showing occurrences and depth of the FORAMINIFERA obtained from the Hergott Bore, their bathymetrical range at the present day, and their geological age as hitherto known.

Family.	Genera and Species.	Depth from Surface in ft. 15	20-40	40-50	50-55	100-200 Bivalves	200	100-300	304-306	306-309	S. Shallow Water D. Deep Water C. Comm. to both	P. Palæozoic M. Mesozoic T. Tertiary R. Recent
ASTRORHIZIDÆ— Sub. Fam. *Rhabdammininæ*	Hyperammina vagans, *Br.*				x				x		C	M(?)P
LITUOLIDÆ— Sub. Fam. *Lituolinæ*	Reophax fusiformis, *Will.*	x	x	x	x	x					S	R
" "	" ampullacea, *Br.*	x			x						S	R
" "	" scorpiurus, *Montf.*		x		x	x					C	M
" "	Haplophragmium agglutinans, *d'Orb.*	x	x	x	x						C	M
" "	" " *var.* rectum, *Br.*	x	x		x	x		x			C	P
" "	" (?) canariense, *d'Orb.*		x	x	x	x	x	x	x		S	R
" "	" species			x		x						
" "	Placopsilina cenomana, *d'Orb.*									x	S	M
" *Trochammininæ*	(?) Thurammina papillata, *Br.*	?			x						D	M
" *Endothyrinæ*	(?) Nodosinella sp.	x				x						P
" "	(?) Endothyra Bowmani, *Phil.*					x						P
TEXTULARIDÆ— Sub. Fam. *Textularinæ*	Bigenerina nodosaria, *d'Orb.*	x		x		x					S	T
" "	" digitata, *d'Orb.*	x			x	x					S	T
" "	Gaudryina pupoides, *d'Orb.*	x	x	x	x						D	M
" "	" (?) scabra, *Br.*			x		x			x	x	C	R
" "	Verneuilina polystropha, *Reuss*					x					S	R
LAGENIDÆ— Sub. Fam. *Nodosarinæ*	Nodosaria radicula, *Linné*						x				C	P
[illegible]	[illegible]		x			x					S	M

Supplemental Notes on the Palliobranchs of the Older Tertiary of Australia, and a Description of a New Species of Rhynchonella.

By Professor Ralph Tate, F.G.S., F.L.S., &c.

[Read October 6, 1885.]

The following notes are addenda to my paper on "The Palliobranchs of the Older Tertiary of Australia," published in these transactions for the year 1880:—

I. New Species.

Rhynchonella Baileyana, *Tate*. Plate vi., figs. 3*a*—3*c*.

Ref.—Southern Science Record, January, 1885, p. 1.

Shell transversely ovate-trigonal, sub-depressed; dorsal valve regularly convex from the umbo to the middle, thence flattish to the front of the mesial fold, which is broad and not very prominent; the ventral valve is less convex, with a broad sinus of moderate depth commencing at half the distance from the beak and extending to the front. The anterior-fourth of each valve is plaited and circumscribed by a conspicuous fold of growth; there are seven plaits on the mesial fold and about four on each lateral area. The mesial fold occupies about one-third of the front of the shell, rising abruptly from the lateral areas. The beak is very small, moderately produced, with a minute circular foramen under its angular and slightly-incurved extremity which is surrounded and separated from the hinge line by a deltidium of two pieces.

Length, 25; breadth, 18; thickness, 12 millimetres.

The species is dedicated to the memory of Mr. John F. Bailey, late of Melbourne, to whose enthusiasm for science he recently fell a martyr, by whom it was collected at Jemmy's Point, at the entrance to the Gippsland Lakes.

Rhynchonella Baileyana is an interesting addition to the palliobranch fauna of the Australian Tertiary period, inasmuch as it differs so widely from living and Tertiary species, and recalls some Mesozoic ones. I do not know of any other fossil which has so depressed and broadly oval form conjoined with marginal plications and a small sub-erect beak as it possesses

II. Species still Living.

Rhynchonella squamosa, *Hutton*.

This species in a living state was taken off south of Kerguelen Island during the Challenger expedition, and has been redescribed by Mr. Davidson in Brachiopoda of the Challenger Exped., t. 4, f. 14, p. 59 (1880), as *R. nigricans*, var. *pixydata*.

Digitized by Google

III. Additions to the Provincial Lists of Species and Localities.

Victoria.—Terebratula vitreoides, *T. Woods*. Muddy Creek. J. Dennant!
Waldheimia Garibaldiana, *Davidson*. Corio Bay!
insolita, *Tate*. Corio Bay! Muddy Creek, near Hamilton, and Limestone Creek, near Ascot, Glenelg River. J. Dennant!
grandis, *T. Woods*. Limestone Creek, J. Dennant!
Terebratulina Scoulari, *Tate*. Balcombe and Corio Bays!
lenticularis, *Tate*. Corio Bay!
Magasella compta, *Sowerby*. Mordialloc, J. F. Bailey! Muddy Creek, J. Dennant!
Rhynchonella Baileyana, *Tate*. S. Gippsland, J. F. Bailey!

Tasmania.—Extracted from paper by Mr. R. M. Johnston in Proc. Roy. Soc. Tasm. for 1884, p. 223:—
Waldheimia furcata, *Tate*.
Johnstoniana, *Tate*.
grandis, *T. Woods* (*!*)
Corioensis, *McCoy*.
pectoralis (?), *Tate*.
Terebratulina Scoulari (?), *Tate*.
lenticularis, *Tate*.
triangularis, *Tate* (*!*)
Terebratella Tepperi, *Tate*.

South Australia.—From the clayey sands with green grains pierced by the bore sunk at the Waterworks Yard, Adelaide:—
Terebratula vitreoides, *T. Woods*.
Waldheimia insolita, *Tate*.
Terebratulina Scoulari, *Tate*.
lenticularis, *Tate*.
Terebratella furculifera, *Tate*.

IV. Species Common to the Older Tertiary of Australia and New Zealand.

Magasella Woodsiana, *Tate*. (*Waldheimia tapirina*, Hutton.)
Terebratula Aldingæ, *Tate*.
Terebratella furculifera, *Tate*.
Waldheimia insolita, *Tate*.
Terebratulina Scoulari, *Tate*. (*Waldheimia Suessii*, Hutton.)
Rhynchonella squamosa, *Hutton*.

The first identification is on the authority of Prof. F. W. Hutton, by whom it has been communicated to me *in litteris*; the others are based upon comparisons of actual specimens made by myself.

Digitized by Google

The Lamellibranchs of the Older Tertiary of Australia. (Part I.)

By Professor Ralph Tate, F.G.S., F.L.S., &c.

[Read October 6, 1885.]

Plates II.—XII.

FAMILY OSTREIDÆ.

Genus Ostrea.

SYNOPSIS OF SPECIES.

I. Valves radially ribbed, spinose.	*O. hyotis.*
II. Valves foliated or smooth—	
Elongate; beaks produced	*O. Sturtiana.*
Oblong; beaks subspiral.	*O. arenicola*
Broadly attached, with erect front; beaks depressed.	*O. hippopus.*

Subgenus Gryphæa.

Umbo of lower valve largely incurved.	*G. tarda.*

Ostrea hyotis, Linn. Plate vi., fig. 5.

Ref.—Reeve, Monogr. Ostrea, t. 4, fig. 7.

"Shell irregularly subquadrate, solid, armed with tube-shaped spines standing out upon the angles of about seven large folds; auricles rather compressed foliaceous plicated."—*Reeve.*

I refer a very common oyster in the Middle Murravian series, with some hesitation, to the above-named species inhabiting the Indian Ocean; the fossil, however, rarely exhibits tubular spines, more generally broad foliaceous scales; in shape it varies from subquadrate to semicircular and obliquely oblong; the plications usually angular, are sometimes rounded when it approaches to *O. imbricata*, Lamk. In the absence of examples of the fore-named living species, I refrain from separating our fossil.

Dr. K. Martin has figured, under Linnæus' name, an oyster from the Older Tertiary of Java,* a variety of which is oblong. According to this author, the same species occurs in the Indian Tertiary beds, whence it has been described as *O. tubifera*, Sowerby in Trans. Geol. Soc., v., tab. 25, fig. 19., 1837.

Localities.—Calciferous sand rock, River Murray-cliffs at

* Die Tertiarschichten auf Java, p. 125, t. 21, figs. 1 and 2, 1880.

Digitized by Google

Mannum, Blanchetown, Morgan, &c., very common; mouth of the Onkaparinga River, St. Vincent Gulf, one example (*R.T.*).

Ostrea Sturtiana, *spec. nov.* Plate vi., fig. 1.

Shell narrowly oblong to subtrigonal, test very thick, margins not denticulated; upper valve nearly flat, ornamented with depressed lamellæ, margin included in the lower valve, which is attached by a small part of the umbonal area or apparently free. Lower valve moderately deep, externally radially wrinkled and scaly lamellose; hinge of lower valve narrow, elongated, deeply and broadly channelled in the middle; hinge of upper valve shorter and broader. Muscular impression very large, somewhat reniform.

Dimensions.—Height, 85; breadth, 53; thickness through both valves, 40 millimetres.

Among recent species it approaches some varieties of *O. edulis*, but on account of its ponderosity, dissimilar ornament of the valves, and the large hinge, it may usefully have a specific designation applied to it. And I associate with it the name of Captain Sturt, who refers to this species under the name of *O. elongata*, Deshayes (*O. cucullaris*, Lamk.).

Locality.—This species constitutes banks up to ten feet or more in thickness in the upper part of the River Murray-cliffs from Overland Corner to beyond Blanchetown.

Ostrea arenicola, *spec. nov.* Plate x., fig. 6.

Shell roundly-oblong, somewhat produced anteriorly, rather compressed, solid, valves not very unequal; umbos depressed, slightly bent forwards. Lower valve moderately convex, attached by a small part of the umbonal area or free; marked with many roundly depressed radial ribs and foliaceous lamellæ. Upper valve flattish or sharply convex, smaller than and included within the lower valve, marked with flattened imbricating lamellæ.

Dimensions.—Height, 80; breadth, 85; thickness through both valves 25 millimetres.

The nearest ally is the southern analogue of *O. edulis*—the Port Lincoln oyster, *O. Angasi*—from which it differs in the depressed and forward-directing umbos, in the greater width at the front, and more decidedly costated; by the same characters it is separated from *O. Sturtiana*.

This species is usually found in the sand-beds alternating with the hard calciferous sandstones which form the topmost of the fossiliferous strata at Adelaide and in the cliffs at Aldinga Bay. It has seemingly been the habit of the species to attach themselves to one another or to be free.

Examples attached by a moderately large surface resemble

Digitized by Google

O. corrugata, Hutton, but the single specimen of that species which I possess is too imperfect for critical comparison.

An extreme variety occurs in the Upper Murravian at the North-West Bend, attached to *Meleagrina* by whole surface, except a narrow erect expansion which is externally laminated and occasionally plicatedly wrinkled; the upper valve is smooth and has the pointed recurved umbo so characteristic of the Aldinga specimens.

A thin-shelled form, having much resemblance to the last variety, which was obtained from the Adelaide bore may for the present be associated therewith.

Localities.—Upper Aldinga series at Aldinga and Adelaide.

Var. *a.*—Upper Murravian, North-West Bend, on the River Murray.

Var. *b.*—Lower Aldinga series at Adelaide. A minute valve having a thick test showing irregular structure from Schnapper Point, Hobson's Bay.

Ostreahippopus, *spec. nov.* Plate iv., figs. 1*a*—1*b*.

Shell suborbicular, inequivalve; hinge-line straight, umbo depressed, sub-central. Upper valve nearly flat, undulose towards the margin, which is included within the lower valve; surface with irregularly concentric lamellæ. Lower valve attached by a very large surface with an erect margin, which is externally faintly wrinkled and striate longitudinally, and lamellose concentrically.

Dimensions.—Length, 66; height, 60; depth of elevated front, 40 millimetres.

Locality.—Glauconitic limestone, Aldinga Bay.

Subgenus Gryphæa.

Gryphæa tarda, Hutton. Plate vi., figs. 2*a*—2*b*.

Ref.—Hutton in Cat. Tert. Foss. of New Zealand, p. 35, 1873.

Shell rather thin, oblong or irregularly rotund.

Inferior valve tumid very convex, smooth, with broadish folds of growth; free or sessile by a small umbonal area; anterior-ventral margin produced into a conspicuous lobe; umbo subacute, incurved and bent forward; ligamental area broad, moderately excavated medially; muscular impression oblong, situated towards the margin on the produced side. Superior valve flat with an elevated margin, ornamented with imbricating lamellæ.

Dimensions.—Inferior valve, height, 45; breadth, 32; thickness, 23 millimetres.

Localities.—Glauconitic limestones and polyzoal rock, north side of Blanche Point, Aldinga Bay; chalk rock of the Bunda

Digitized by Google

Cliffs, Great Australian Bight, South Australia (*R. Tate*). Chatham Islands, New Zealand (*Hutton*).

Observations.—Our fossil cannot be mistaken for the recent *G. angulata*, Lamarck, but it bears a close resemblance to the Cretaceous *G. vesicularis*, Lamarck, from which it differs in its more triangular outline, larger lobation, and in the superior valve being lamellose. In my description of the chalk-rock of the cliffs of the Great Australian Bight I have remarked that, "on a cursory inspection one is struck by its similarity to the chalk of England, heightened by the presence of layers of black flints and of fossils with a Cretaceous facies such as *Salenia* (*S. tertiaria*, Tate), *Cidaris* (*C. australasiæ*, Duncan), *Gryphæa* (*G. tarda*, Hutton), like *G. vesicularis*, a *Terebratula* (*T. subcarnea*, Tate) barely distinguishable from *T. carnea*, *Terebratulina*, &c." Trans. Roy. Soc., S. Aust., 1879.

Hitherto *G. tarda* has been found at the Australian localities only in the lowest beds of the marine series of the Older Tertiary. I am not sure if our fossil is correctly named, as I have not had specimens of the New Zealand species for comparison, it answers fairly well to Hutton's diagnosis, except that it is only of about half the size. The original description reads as follows:—Irregularly ovate, umbo of left valve incurved and bent slightly forwards; exterior smooth, with concentric striæ; right valve rather concave, often thickened near the margin, much smaller than the left valve; area broad triangular, distinctly transversely striated; muscular impression suborbicular, rather flattened above where it is deeply sunken, posterior, placed high up; height 2·4, length 1·7 inches.

Genus Dimya, *Rouault.*

The genus *Dimya* was founded for an oyster-like fossil of the Parisian Eocene with a second adductor impression, and by most conchological writers has been placed in the family Ostreidæ, the additional scar being regarded as the homologue of the small anterior scar in *Pecten*. Tyron* seems to have studied a living example of the genus dredged off the Antilles, which he describes as "essentially an oyster having two adductor muscles, the exterior layer of the shell pearly, the inner porcellanous, hinge with a pit like *Hinnites*." He follows Stolickza (in "Cretaceous Pelecypoda of Southern India") in placing the genus in the sub-family Vulsellinæ, family *Aviculidæ*. As the anatomy of *Dimya* agrees with that of *Ostrea*, the original position assigned to the genus in the scheme of classification would thus appear to be the correct one, despite the fact of its dimyarian character.

* Systematic Conchology, vol. iii., p. 281, 1884.

Digitized by Google

The two new species which I refer to *Dimya* have the general aspect of *Plicatula* rather than of *Ostrea*; whilst the two diverging cardinal ridges make an approach to *Placuna*, though functionally different. The internal characters presented by them are as follows:—

Right valve attached, with two diverging cardinal ridges crenulated for the greater portion of their length; cartilage pit triangular, with a raised margin, within the angle formed by the cardinal ridges. Posterior muscular impression large oval, in about the same position as the single scar in *Plicatula*; the anterior scar is ovate, small but deeply impressed, close under the end of the cardinal ridge; pallial line entire. Left valve free, with two diverging cardinal furrows crenulated within the grooves.

SYNOPSIS OF SPECIES.

Coarsely radially ribbed; internally ribbed.	*D. sigillata*
Finely radially ribbed; margin only ribbed.	*D. dissimilis*

Dimya dissimilis, *spec. nov.* Pl. iii., figs. 9*a*—9*c*.

Shell ovate-oblong to ovate-triangular; inequivalve, inequilateral, posteriorly oblique; umbo sub-central, dorsal line usually straight. Right valve attached by varying extent of surface; free part obliquely elevated, slightly convex, ornamented by many high-rounded ribs frequently bifurcating towards the front, crossed by lamellæ which give rise to imbricating scales or spinous scales on the radial ribs. Left valve free, flattish, a little swollen in the umbonal region, depressed centrally, and elevated at the margin; scaly fringed with imbricating lamellæ. Interior of both valves with radial riblets interposed between the pallial line and the shell margin most conspicuous in the dorsal region.

Dimensions.—Length, 10; height, 13 millimetres.

Localities.—South Australia: Gastropod-bed, near Morgan and elsewhere in the Middle Murravian, in the raggy limestones at Mannum, on the River Murray; Salem, near Callington, on the R. Bremer; Rolls Point, Nepean Bay, Kangaroo Island. Victoria: Muddy Creek, Hamilton, and Corio Bay Geelong (*R.T.*)

Dimya sigillata, *spec. nov.* Plate viii., figs. 8*a*—8*b*.

Shell ovate-oblong, inequivalve, subinequilateral, posteriorly somewhat oblique; umbos subcentral, dorsal line usually straight.

Right valve attached by a large surface, free part much elevated, ornamented by numerous rounded radial riblets and a few imbricating lamellæ of growth. Left valve free, slightly concave, except in the umbonal region, included within the

Digitized by Google

right valve; faintly rayed and concentrically laminated. Interior of both valves with conspicuous radial riblets within the pallial line and terminating there; the denticulations of the cardinal ridges continuing on the lateral margins and gradually developing into riblets.

Dimensions.—Length, 6·5; height, 7·5 millimetres.

Localities. — Turritella clays and glauconite limestones, Aldinga; glauconite sands, Adelaide bore; chalk-rock, Bunda Cliffs of the Great Bight.

D. sigillata differs from *D. dissimilis* in the erect front of the attached valve and finer ornament, and by the radial riblets within the pallial line; in the last particular this species recalls certain *Plicatulæ* of the Cretaceous and Jurassic rocks of Europe. *D. sigillata* approaches externally rather to *Ostrea* than to *Plicatula*, whilst the converse is true of its congener, *D. dissimilis*.

FAMILY ANOMIIDÆ.

Anomia cymbula, *spec. nov.* Plate ix., fig. 5.

Shell obliquely oblong-ovate, somewhat solid, convex, with compressed sides; umbo subcentral, acute, perceptibly elevated, submarginal; surface densely rayed with slender riblets, which are covered with subspinous transverse scales.

Dimensions.—Height, 10; length, 5; depth of valve, 3·5 (nearly) millimetres.

Locality.—Turritella-clays at Blanche Point, Aldinga Bay.

Genus Placunanomia.

SYNOPSIS OF SPECIES.

Valves ornamented with coarse radial threads, subspinose. *P. Ione.*

Valves ornamented with fine radial threads. *P. sella.*

Placunanomia Ione, *Gray.* Pl. v., figs. 7*a*—7*b*.

References.—Proceedings Zoological Society, 1849, p. 123; Hutton, in Cat. Marine Moll. of N.Z., 1873, p. 84.

Superior or left valve irregularly orbicular, usually slightly convex, but varying from flat to very convex, horny-pellucid, surface ornamented with imbricating scaly lamellæ and radial threads or ridges; umbo sub-marginal, depressed, with a slight back curvature. Ligamental scar within the umbonal cavity transverse oblong, circumscribed by a raised border, radially striated, adjacent to the anterior margin of which is a small conspicuous pedal scar.

Dimensions.—Length, 54; height, 47 millimetres.

Localities.—Oyster banks of the Upper Murravian at the North-West Bend, and of the Upper Aldinga series at Aldinga

Digitized by Google

and Adelaide. Muddy Creek, Hamilton, a few small flat smooth examples (*J. Dennant*).

It is not with confidence that I refer the fossil under review to the recent species inhabiting the waters of the New Zealand and South Australian shores. It exhibits, however, very great variation, especially in respect to the radial ornamentation. Usually the rays are obsolete, except towards the margin. In other examples the rays are moderately strong and numerous, as in recent examples, but occasionally the ribs are thickened, elevated, and raised into sub-spiny scales, the ribs being generally few in number.

Though the attached valve is unknown, despite the fact that several score of the free valves have been collected, yet there cannot be a doubt that it is correctly placed in the genus *Placunanomia*, as the shelly base of the plugs are conspicuous objects on oysters and other molluscous shells associated in the same deposit.

Placunanomia sella, *spec. nov.* **Pl. v., figs. 1*a*—1*c*.**

Shell suborbicular to triangular-ovate, thin, inequivalve, inequilateral; umbos depressed, marginal. Left valve convex from the ventral to the dorsal margin, with lateral areas more or less elevated; right valve concave, with depressed sides, sinus small pyriform. Surface of both valves ornamented with numerous radial threads and lamellæ of growth. In young shells the radii are minutely scabrous; a variable character consists of radial and concentric undulations. Interior of left valve with a submarginal oblique cartilage pit and two oval subcentral muscular impressions; the latter are superimposed, that produced by the muscle of the plug the larger. Interior of right valve with a single adductor impression within the posterior margin of the disc, posterior lobe of notch overlapping on the anterior lobe, and more or less agglutinated therewith; the margin of the notch with a raised border. In adult specimens the marginal border is excessively developed to form a tubular sheath, to which the shelly base of the plug becomes adherent.

Dimensions of a largish specimen.—Length, 43; height, 40 millimetres.

Localities.—South Australia: Abundant in the basal part of the calciferous sandstone of the River Murray cliffs at MacBean's Pound, near Blanchetown; in a well-sinking, "Nine-Mile Camp," near the North-West Bend (*R.T.*)

Tasmania: Table Cape, determined from a left valve received from Mr. R. M. Johnston.

Victoria: A thin, translucent form, with flattish sides, is common at Muddy Creek; a very small example, Schnapper Point, Hobson's Bay (*R.T.*)

Digitized by Google

New Zealand: Two left valves of an unnamed "Ostrea, No. 175, from Oamaru Creek, Otago," received from the Wellington Museum, are comparable with the triangular-ovate form of *P. sella*. The two subcentral muscular scars so characteristic of the genus are well displayed.

FAMILY PECTINIDÆ.

Genus Pecten.

SYNOPSIS OF SPECIES.

I. Radially ornamented.
  1. Inequivalve, interspaces with shagreen-sculpture.
    Eight radial folds and many riblets. *P. consobrinus.*
    Twelve truncated ribs. *P. subbifrons.*
    Seven broad plications or compressed plicæ. *P. palmipes.*
  2. Inequivalve; no shagreen-sculpture.
    Ribs simple. *P. Murrayanus.*
    Ribs dichotomously divided. *P. dichotomalis.*
  3. Equivalve; radial ribs more or less scaly.
    Ribs 25, flatly rounded, one or two riblets on each flank. *P. antiaustralis.*
    Ribs 25, rounded, broader than interspaces, densely squamose. *P. Eyrei.*
    Ribs 35-40, flatly rounded. *P. Flindersi.*
    Ribs 35-40, acute; one riblet on each flank. *P. Peroni.*
    Ribs 30, flatly rounded equal to the furrows. *P. Sturtianus.*
    Ribs 50, narrow; oblique-linear sculpture in the interspaces. *P. Aldingensis.*
    Ribs 60-70, very narrow. *P. Yahlensis.*
  4. Radially plicate and ribbed with spinose ornament.
    Flat; plicæ 9, intermediate ribs 9. *P. Foulcheri.*
    Inflated; plicæ 7-9, intermediate ribs 7-9. *P. spondyloides.*
  5. Radially plicate and ribbed with scaly ornament.
    Radial folds 7-9, simple. *P. Gambierensis.*
    Radial folds bifurcating; corrugated. *P. polymorphoides*

II. Valves smooth, or nearly so.
  Surface concentrically striated; ears plain. *P. Hochstetteri.*
  Surface faintly rayed; ears rayed. *P. Yahlensis.*

III. Valves with *internal ribs.*
  Valves smooth or concentrically striated, internal ribs 30-36 pairs. *P. lucens.*
  Valves concentrically or reticulatedly striated or ribbed; internal ribs 9. *P. Zitteli.*

Digitized by Google

Pecten consobrinus, *spec. nov.* **Plate iii., fig. 6.**

Shell orbicular, fan-shaped, slightly convex, equilateral, subinequivalve, the left valve somewhat flatter. Ornamented with about eight radial folds and numerous (about 100) thickish riblets; the riblets are rigid, unequal in size, and separated by irregular intervals which are minutely granular and usually broader than the riblets.

Right valve with rayed, unequal ears; anterior ear larger, subaliiform, slightly notched on the underside; posterior ear triangular, perpendicularly truncated. Ears of left valve unequal, radially ribbed; the anterior one larger, triangular, outer margin curved; posterior ear triangular, perpendicularly truncated.

Dimensions.—Length and height about 85 millimetres.

Localities.—Oyster banks of the Upper Aldinga series at Aldinga and Hallett's Cove, St. Vincent Gulf.

It is with some hesitation that I separate these shells from *P. bifrons*, but the slight differential characters relied on are observable at all stages of growth; thus left valves of 15 millimetres diameter are distinguished by their three-ridged radial ribs; at 30 millimetres diameter, whilst *P. bifrons* has yet the elevated simple scaly ribs and plain furrows, *P. consobrinus* has almost lost the plicæ which are replaced by four or five threads, and about three occupy the furrows; these divergencies culminate in the very numerous radial threads and obsolete folds of the adult. Similar changes are observable in the other valve. *P. consobrinus* is moreover less inequivalve than *P. bifrons*.

Pecten subbifrons. Tate. Plate iii., fig. 2.

Ref.—Proc. Roy. Soc. S. Australia, vol. iv., p. 44, 1882.

Shell orbicular or triangularly orbicular, fan-shaped, equilateral, slightly inequivalve, umbos depressed.

Right valve slightly convex, rayed with twelve compressed truncated ribs about equalling in width to the deep flatly concave furrows; the ribs carry two or three irregularly granular nodose riblets, and there may be one or two raised lines in the furrows. The surface, save on the riblets, granular-shagreen. Ears rayed, unequal; the interior one much larger, outwardly curved and sinuated below; posterior triangular. Left valve rather flatter than the right, but with similar ornament; ears subequal, obtuse-angled, rayed. Interior of both valves plicated but not ribbed.

Dimensions.—Length and height, 50 millimetres; a smaller specimen, length 28, height 30 millimetres.

Localities.—Oyster beds, Government house quarry, Adelaide *(R.T.)*, Polyzoal-bed, mouth of R. Onkaparinga.

Digitized by Google

This species, which has the general form and shagreen-sculpture of *P. bifrons*, differs from it chiefly by its compressed truncated and more numerous ribs; the valves are flatter and the ears, particularly of the right valve, differ somewhat.

Pecten palmipes, *spec. nov.* Plate v., fig. 4. Plate vii., figs. 4*a*—4*b*.

Shell triangularly orbicular, inequilateral by projection of posterior part; slightly inequivalve, the right valve a little more convex than the left; ears large subequal, umbos depressed. *Right valve* rayed with seven broad rounded plications, gradually becoming broader and flatter as they approach the margin; the interstitial spaces are narrow and deep. The whole surface rayed with numerous linear ridges, the interspaces minutely granulated. Posterior ear triangular, obliquely truncated, rayed; anterior ear, larger, projecting, outer margin curved, indented on the under side, radially ridged. *Left valve* more depressed in the umbonal region, rayed with six compressed elevated plicæ, the flatly rounded surfaces of which are bordered by two furrows, increasing in number towards the front; the interstitial spaces between the plicæ are very broad and deeply concave, bearing riblets in old shells towards the margin. Spaces between the riblets minutely granulated. Ears triangular obliquely or perpendicularly truncated, radially ridged, subequal, the anterior one larger.

Dimensions of largest specimen.—Length 71, height 71, thickness through both valves 27 millimetres.

Localities.—Edithburgh, Yorke Peninsula; oyster banks, Aldinga Bay.

This species has the general characters of the recent South Australian *P. bifrons*, of Lamarck, possessing also its peculiar granular shagreen-sculpture; but it differs by the obliquity of its valves, in being higher than long, and in the form of its radial plicæ; the interior is plicated but not ribbed as in the living species.

Pecten Murrayanus, *spec. nov.* Plate vii., figs. 5*a*—5*b*.

Shell orbicular, fan-shaped, somewhat thin, scarcely equilateral, projecting slightly in front, inequivalve; valves rayed with about 20 rounded ribs broader or equal in breadth to the concave furrows, the whole crossed by close-set, thin, erect lamellæ coincident with the margin; the lamellæ increase in denseness from the umbo forward. Interior with flat ribs corresponding with the exterior furrows.

Left valve slightly and regularly convex; umbo acute, not extended beyond hinge line. Ears unequal, the anterior large roundly truncate, finely striated, perpendicularly and faintly rayed; the posterior elongate, arcuate, prominently rayed and concentrically striated.

Digitized by Google

Right valve nearly flat, depressed at the umbo; ears equal truncate, finely striated perpendicularly, faintly rayed.

Dimensions.—Length, 47; height, 45; thickness through both valves, 10 millimetres.

Localities.—Common in the calciferous sandstone of the Middle Murravian, Blanchetown, &c.; rare in the Lower Murravian at Mannum. Not uncommon at Muddy Creek, Hamilton.

This species belongs to a small group represented by *P. solaris*, Born, but it is not identical with any of the living species monographed by Reeve. *P. solarium*, Lamk., a fossil species of the European Tertiary, is also of the same type, but *P. Murrayanus* is distinguished by its fewer ribs and smaller wings.

P. leopardus, Reeve, is its nearest ally, but the ribs are fewer, separated by wide interspaces, and is scarcely equivalve.

Pecten dichotomalis, *spec. nov.* Plate ix., figs 3*a*—3*c*.

Shell suborbicular, fan-shaped, thin, equilateral, inequivalve umbos depressed. Right valve regularly slightly convex, with about nine broad radial undulose folds, whole surface ornamented with flat riblets narrower than the interspaces which are crossed by raised threads about half the width of the alternating grooves. The riblets increase in number to more than 100 by two successive bifurcations at irregular intervals, and towards the margin are covered with minute imbricating scales; front margin undulate and minutely crenulated. Ears unequal, dorsal line distantly serrately fringed; anterior ear slightly sinuated on the underside, with five to six radial ridges covered with small triangular serratures; posterior ear triangular, slightly obtuse-angled, with seven to eight serrated ridges. Left valve flat, with the radial folds angular, the riblets stouter and less numerous, the anterior one-fourth of the surface densely covered with conspicuously large, erect scales. Ears large, equal; radial ridges about three on which are a few scattered, erect, triangular scales.

Dimensions.—Length, 32; height, 30; thickness through both valves, 4·5 millimetres.

Locality.—Schnapper Point, Hobson's Bay (*R. T.*).

Pecten antiaustralis, *spec. nov.* Pl. ix., figs. 7*a*—7*c*.

Synonym.—P. asperrimus, var. *Tate.* Trans. Roy. Soc., S. Aust., vol. iv., p. 34, 1882.

Shell sub-orbicular, moderately convex sub-equivalve, the right valve less convex, sub-æquilateral, rayed with about 25 ribs which are flanked by one or two smaller ribs on each; the ribs and riblets are convex, crossed by erect lamellæ, the

Digitized by Google

interstitial furrows flattish, arcuately striated. Ears unequal large, radially ridged and transversely lamellate-scaly; right-posterior, triangular, obliquely truncated, anterior produced, sinuated ventrally; left-posterior similar to corresponding one in right valve, anterior larger, obtuse angled.

Dimensions of a large individual.—Length and height, 58; thickness through both valves, 25 millimetres.

Localities. — Oyster beds in the uppermost strata at Adelaide, Hallett's Cove, and Aldinga Bay; Edithburg and Stansbury, Yorke Peninsula (*R.T.*).

This species is very closely allied to *P. australis*, Sow., which is probably identical with *P. asperrimus*, Lamarck, but as my comparisons have been made with what is certainly the former, my remarks have reference only to it. The chief differences observable are the *lamelliform* ornamentation of the convex ribs and riblets, whilst in *P. australis* they are angular, and beset with distant scaly serratures or spinous scales; moreover the valves, especially the left valve, is more convex.

The young of the two species are much alike, having simple ribs, developing with age a riblet on each side. Rarely does *P. australis* acquire more, but *P. antiaustralis* does so as a rule, and aged examples exhibit two or three on each flank, and often one in the furrow, whilst the concentric lamellæ are continuous across the furrows.

The ears of the fossil species are larger, and the shell attains to greater dimensions.

P. antiaustralis, however, exhibits variations in the degree of convexity of the valves and ribs, whilst *P. australis*—the commonest shell on the S. Australian coast—is true to its type; nevertheless, it is easy to separate the species.

P. actinoides, Sowerby, of the Chilian Tertiary, is apparently a near ally.

Pecten Eyrei, *spec. nov.* Pl. viii., figs. 3*a*—3*b*, 6.

Shell ovate orbicular, scarcely equilateral, sub-inequivalve, slightly convex, ornamented with about 25 rounded ribs as broad or broader than the smooth interspaces; ribs with close-set erect crescentric scales; occasionally a riblet is interposed between the primary ribs towards the front. Ears unequal, radially ridged, and transversely lamellated; of the right valve, the posterior ear triangular, obliquely truncate; anterior ear elongated with a deep byssal sinus; of the left valve, the anterior larger than the posterior with the outer margin curved, the anterior one perpendicularly truncated.

Dimensions.—Length, 45; height, 48; thickness through both valves, 12.

Digitized by Google

Localities.—Chalk rock of the Bunda Cliffs, Great Australian Bight; Polyzoal rock, Aldinga Bay; at mouth of the River Onkaparinga; and at Surveyor's Point, Yorke Peninsula (*R.T.*).

The species may appropriately be named in honour of Sir John Eyre, from the circumstance of its occurrence at Wilson Bluff, Great Australian Bight, whose graphic description of an attempt to scale this bold headland must be familiar to those who have read the narrative of his adventurous overland journey to Perth.

Pecten Flindersi, *spec. nov.* Plate viii., fig. 7.

Shell obovate to triangular, orbicular, equilateral, or slightly inequilateral, equivalve moderately convex, umbos depressed acute, ornamented with from 35 to 40 flatly rounded ribs with broader interspaces. The ribs are smooth or surmounted by distant minute scales; the interspaces are marked with perpendicular engraved lines.

Ears as in *P. Eyrei*.

Dimensions.—Millimetres.

Length.	Height.	Thickness.	No. ribs.
54	56	23	35
51	54	—	40
43	50	—	30
35	37	11	37
77	80	38	40
60	—	15	50

Localities.—Glauconite limestone, Aldinga Bay; glauconite sands, Adelaide bore; clays at Muloowurtie, Yorke Peninsula.

P. Flindersi has a general resemblance to *P. rudis*, G. B. Sowerby in Darwin's Geol. Observ., of the Chilian Tertiary, but that shell has fewer ribs with narrower interspaces.

Species-name in commemoration of Captain Flinders, the intrepid Australian navigator.

Pecten Peroni, *spec. nov.* Plate x., figs. 1*a*—1*b*.

Shell ovate-orbicular, equilateral, equivalve, nearly flat umbos acute, depressed, ornamented with numerous acute or subacute scaly ribs flanked on each side by a scaly riblet interspaces very shallow, a little wider than the ribs, minutely granular. The primary ribs vary from about 35 to 40, and with the riblets are covered by crescentic scales or short triangular spines. Ears as in *P. Eyrei*, but the posterior ones with the dorsal margin usually serrately fringed.

Dimensions.—Length, 39; height, 42; thickness through both valves, 11 millimetres.

Localities.—Polyzoal limestone, Aldinga Bay; Adelaide bore.

Digitized by Google

ecies is more depressed, equilateral, and has more
P. antiaustralis and *P. australis*, whilst the anterior
left valve is not winged.
ecies is dedicated to the memory of M. Peron, the
to the Baudin Expedition, as a mark of my apprecia-
s geological observations on Kangaroo Island.

---

ks on the affinities of the three foregoing species :—
gree in one particular, which distinguishes them from
lis and *P. antiaustralis*, namely, that the anterior ear
ft valve is not winged.
lest species in time is *P. Flindersi*, which is depressed,
mented with numerous, narrow, rounded ribs, smooth
tly scaly; in *P. Eyrei* the ribs are fewer in number,
d densely scaly; whilst *P. Peroni*, which occupies an
ate geological position, has the numerous narrow,
ribs of the former, and the dense scaly ornament
atter, diverging, however to the spinous scales of
lis.

ecten Sturtianus, *spec. nov.* Plate vii., figs. 2*a*—2*c*.
early orbicular, convex, equivalve, equilateral; about
rounded radial ribs covered with distant, thick, imbri-
les, the alternating furrows about as broad as the
ked with transverse or oblique lines. Margin of
enulate-undulate. Right valve with unequal ears;
rior larger, triangular, and subaliiform, strongly rayed
lar or spinosely scaly; the anterior ear triangular,
ree-rayed, with perpendicular lamellæ conspicuous
ards dorsal margins, and obliquely striated. Left
sterior ear elongately produced, narrow, deeply exca-
a byssal sinus, four nodular-scaly ribs; anterior
ilarly ornamented to corresponding ear in the right

ions. — Length, 18; height, 18·5; and thickness
oth valves, 10 millimetres.
ies.—Not uncommon in the Calciferous sandstones of
urray cliffs at Blanchetown, &c.; raggy limestones at
(*R. T.*); rare Muddy Creek, Hamilton.
ecies is dedicated to the memory of Captain Sturt, the
eologist of the basin of the Lower Murray river.
tianus has a general resemblance to *P. Malvinæ*, of
ese Miocene.

ecten Aldingensis, *spec. nov.* Pl. vii., figs. 1*a*—1*c*.
rbicular, or a little longer than high, thin, sub-
l, inequilateral. Right valve moderately convex,
flatter, ears unequal; both valves ornamented with

Digitized by Google

about 50 narrow, rounded, sub-depressed ribs, straight or slightly flexuous, with narrower interspaces, which are sculptured with oblique linear sulci and punctures; towards the front margin a few indistinct concentric lamellæ cross the ribs.

Right valve with the ears very unequal, the anterior aliiform, radially and concentrically scaly-striated, ventral margin sinuated for the passage of a byssus; posterior ear triangular, vertically and radially scaly-striated.

Left valve with unequal ears, the posterior one the smaller; both triangular, and radially costated and scaly.

Dimensions.—Length and height, 32 millimetres.

Locality.—Glauconitic limestone, Aldinga Bay.

Pecten Yahlensis, *Tenison-Woods.*

References.—Phil. Soc., Adelaide, 1865, t. 1, fig. 4; *P. Yahlensis*, var. *semilævis*, McCoy, Prodr. Pal. of Victoria, Decade iv., t. 34.

Shell sub-orbicular, thin, equilateral; valves unequal, and with dissimilar sculpture.

Right valve deeper than the left, moderately convex, polished; surface radiated with numerous (60-70) sub-equal, nearly straight, narrow, flatly-rounded ridges, separated by shallow concavities, rather less than the width of the ridges, crossed by distant concentric lines of growth. Ears, with the posterior one a little larger than the anterior; both slightly obtuse-angled, radially ridged, and marked with concentric lines of growth, which rise on the dorsal margin as projecting angular scales; anterior ear slightly sinuated anteriorly for passage of byssus.

Left valve nearly flat, surface radiated with nearly straight, narrow, rounded ridges, about one-third of their width apart, crossed by sharp, erect, crowded, concentric lamellæ. Ears about equal, slightly obtuse-angled, radially ridged, crossed by concentric lamellæ, which form a serrated fringe on the dorsal margin.

In the *var. sublævis* the right valve is quite smooth, whilst another variety has the rostral portion smooth, and the marginal portion radiately ridged.

Dimensions of average sized specimens.—Length and height, about 55 millimetres; but specimens are known from four to five inches in diameter.

Localities.—South Australia: Mount Gambier limestone (*Tenison-Woods*); raggy limestones at Mannum, R. Murray (*R.T.*)

Victoria: Muddy Creek (*R.T.*); Mordialloc; Corio Bay; Bairnsdale; Schnapper Point, Hobson's Bay; near mouth of Sherbrook River (*McCoy*).

Digitized by Google

"This fossil resembles the well-known German Miocene Tertiary species, the *Pecten Hofmanni* of Goldfuss, so nearly that at first sight one might mistake one for the other; the ridges, however, are slightly larger, usually more nearly equal and less rigid in this species, which is totally distinguished by having the right or deeper valve different from the other, while they are both alike in the *P. Hofmanni*" (*McCoy, op. cit.*).

Pecten Foulcheri, Tenison Woods.

Pecten sp., Sturt. Two Exped., &c., tab. 3., fig. 14.

Pecten sp., Tenison Woods, Geol. Observ., p. 74 (1862).

P. Foulcheri, Tenison Woods, Proc. Phil. Soc. Adelaide, 1865, tab. 1, fig. 3.

Shell thin, equivalve, inequilateral by projection of the front; valves flatly convex with about nine radial angular plicæ on which are scattered towards the front spinous imbrications passing to squamose imbrications on the umbonal region, the concave furrows and sides of plicæ with about nine raised lines, squamosely imbricate especially towards the umbo, the whole crossed by fine concentric striæ.

Ears very unequal; the left anterior moderately large triangular ornamented with three to four rays, squamosely imbricated towards proximal end, and concentric striæ. Left posterior large aliiform with a deep byssal sinus, ornamented with five or six squamosely-imbricate rays. Right anterior as left anterior. Right posterior much larger, subaliiform with several scaly rays.

Dimensions of an averaged specimen.—Length 33, thickness 34, thicknes through both valves millimetres. A large specimen measures 41 by 43 millimetres.

Localities.—Somewhat common in the Mount Gambier limestone *(Tenison Woods)*; very abundant in the Calciferous sandstone of the River Murray Cliffs (*R. Tate*); Table Cape, Tasmania *(R. M. Johnston!)*; rare Muddy Creek.

Tenison Woods' illustration of this species is a good representation of the common form, around which may be grouped several varieties; whilst individual variations have been developed to such extremes that it would be justifiable to establish three or four species out of them if the connecting variations were awanting.

In the typical form the spinous-processes on the plicæ are slender and distant, occasional examples show crowded large imbricating squamæ and the ornament on the interstitial ridges equally gross. Again the plicæ are broad and convex; in others the flanking ridges to the plicæ acquire the magnitude of the central ridge, this state is usually accompanied by almost obliteration of the furrows and the substitution of scales for spines.

Digitized by Google

The plicæ only are usually continued as smooth angular ridge on the umbonal portion, the whole surface of which is delicatel shagreen-sculptured. In some examples the shagreen-marking cover the whole shell, whilst in others the plicæ and raise lines maintain their scaly ornament to the umbo.

Pecten spondyloides, *Tate*. Pl. iv., figs. 6 and 7.

Reference.—Proc. Roy. Soc., S. Australia, vol. iv., p. 44, 188

Shell equivalve, equilateral, about as long as high, inflate covered with numerous spiniferous ribs. There are usuall seven or nine primary ribs, two or three secondaries, and variable number of tertiaries between each pair of primar ribs, all similarly ornamented. Front margin of valve curved, slightly crenulated, not at all angular. Ears equal, c moderate size, triangular, outer margin perpendicular; ther is no byssal sinus.

Variety.—Pl. IV., fig. 7. With the prickly scales of the in terstitial ribs reduced to spine-like serratures, and the spine on the primary ribs slender and distant; regular concentri striæ mark the whole surface.

Dimensions of the figured specimen.—Length and heigh 44; thickness through both valves, 34 millimetres. A larg perfect specimen measures 90 mills. in diameter, whilst frag ments indicate a greater magnitude.

Localities.—Oyster banks of the Upper Aldinga series a Aldinga Bay, Hallett's Cove, and Adelaide. The *variety* i the raggy limestones at Mannum.

This very handsome shell has much the appearance of *Spondylus*, hence its trivial name, and more particularly c *S. imperialis*, of the Chinese Seas; however, it is a Pecten having an edentulous hinge; moreover, the regular curve umbos of both valves presented by shells of all ages are cha racters not belonging to *Spondylus*.

Pecten Gambierensis, *Tenison-Woods*.

Reference.—Proc. Phil. Soc., Adelaide, 1865, pl. i., fig. 2.

Shell thick, inequivalve, the left valve regularly convex, th right flatter; inequilateral by projection of the anterior area ornamented with from five to seven radial folds, which togethe with the interspaces are covered with imbricating, granular close-set ribs, the sulci between the ribs regularly transversely striated. Ears unequal, the anterior one small, truncated the posterior larger, rounded, and strongly ribbed.

Dimensions.—Length and height, about 30 millimetres.

Localities.—Coralline limestone at Mount Gambier and Mosquito Plains (*T. Woods, R.T.*).

The ornament varies in the closeness and stoutness of the radial ribs and their granulations, whilst the plicæ are some

Digitized by Google

times almost obsolete. The species differs from *P. polymorphoides* in its fewer ribs, never bifurcating or presenting intercostal ribs towards the front margin, and by the regular convexity of its valves.

Pecten polymorpholdes, *Zittel*. Plate viii., fig. 2.

Reference.—Pal. von Neu-Seeland, p. 51, t. xi., fig. 3, 1864.

Synonyms.—*Pecten incertus* (*Tenison-Woods*), Proc. Phil. Soc., Adelaide, 1865, tab. i., fig. 1. *P. coarctatus* (*Sturt*), Two Exped., vol. II., t. iii, f. 13; id. *Ten.-Woods*, in Geol. Obs., p. 74, fig.

Shell triangularly orbicular, inequivalve, very inequilateral, projecting anteriorly; convex, inflexed in front; umbonal part irregularly rudely tumulous, rayed with five to seven rather broad ribs; ribs and sulci longitudinally ridged. The ridges, which are covered with imbricating scales, increase in number by bifurcation towards the front, and are there grouped more or less in pairs; interstices between ridges concave, regularly transversely striated; front edge of valve crenulate-dentate. Ears of left valve very unequal; the anterior one is of moderate size, abruptly truncated, with a few scaly rays; the posterior one is elongated, with four stout, coarsely scaly rays; byssal sinus narrow and deep; adductor scar narrow, placed high up on the anterior area.

Dimensions.—Length, 44; height, 40; thickness through both valves, 16 millimetres.

Localities.—Middle Murravian, near Morgan, Blanchetown, and Mannum; Muddy Creek, Hamilton (*R. T.*). Also in the Oamaru series, New Zealand.

P. polymorphoides exhibits some variability in respect to the development of the radial ridges and the corrugations in the umbonal region, and to the extent of the inflexion of the front. Young specimens are nearly equilateral; Zittel's figure represents the species at an early stage of growth, and in which the radial ridges and the ventral inflexion are pronounced; his description does not well apply to the adult shell in respect to the subsmooth or obsoletely striated plicæ, and the auricles as figured by him are not exact. Tenison-Woods' figure of his *P. incertus* represents an averaged-sized specimen, but without corrugations. A specimen of *P. polymorphoides* of about 25 millimetres, sent to me by Professor Hutton, removes any doubt as to the specific identity of the two shells. *P. Burnetti* (Zittel) is a closely-related species.

Among living congeners, *P. polymorphoides* is related to *P. convexus*, Quoy and Gaimard (*P. roseopunctatus*, Reeve, and *P. vellicatus*, Hutton), but its more numerous scaly and slender ridges and the umbonal corrugations distinguish it; and

Digitized by Google

according to Zittel it is allied to the Mediterranean *P. polymorphus*, Br., but I have no specimens of that species for comparison.

Sturt has given a very good figure of a small example of this species, identifying it with the European *P. coarctatus*; Tenison-Woods reproduces Sturt's figure on p. 76 of his "Geological Observations," and in his "Introduction to the Tertiary Rocks of South Australia," Phil. Soc., Adelaide, May, 1865, refers Sturt's shell to *P. Gambierensis*. From this association I dissent, as Sturt's figure well shows the umbonal corrugation and inflexed front so characteristic of *P. incertus*, and moreover *P. Gambierensis* does not occur in the Murray cliffs whilst *P. incertus* is not a rare shell.

Pecten Hochstetteri, Zittel.

Reference.—P. Hochstetterri, *Zittel*, in Palæontologie von Neu Seeland, p. 50, t. xi., figs. 5*a* and 5*c* (non 5b), 1864; and *Hutton* in Cat. Tertiary Fossils of New Zealand, p. 30, 1873.

Synonym.—Pecten pleuronectes, *Tenison-Woods*, in Proc Phil. Soc., Adelaide, 1865, pl. i., fig. 5 (non Gmelin).

Shell nearly orbicular, equivalve, equilateral, thin, compressed; both valves smooth, but when slightly weathered showing fine concentric striæ. Ears of right valve subequal roundly truncated, transversely striated, the anterior one slightly sinuatedly striated. Ears of left valve equal, obliquely truncated, transversely striated. Interior of valves without ribs.

Dimensions.—Longitudinal diameter 58, transverse diameter 60 millimetres.

Localities.—White coralline limestone at Mount Gambier raggy limestones at Mannum, River Murray; the glauconitic limestone, Aldinga Bay; glauconite clayey sands, Adelaide bore; yellow clayey sands, Moolowurtie, Yorke Peninsula Oamaru formation of New Zealand from several localities.

Having specimens of *P. Hochstetteri* from New Zealand, can with certainty announce the fact of this species occurring in the Older Tertiary rocks of South Australia.

Zittel describes the right valve as radially ribbed, which is represented by his fig. 5*b*; but specimens agreeing with his fig 5*a* have been obtained with the valves in opposition, both of which are smooth. Hutton amends Zittel's diagnosis, excluding fig. 5*b*, which belongs to another species, apparently *P. Yahlensis*, Tenison-Woods.

P. Hochstetteri has an external resemblance to the species of the Pleuronectes group, but it is devoid of internal ribs and is equivalve. This type is well represented in the European Jurassic rocks, indeed our species very much resemble

Digitized by Google

P. lunularis, Röm., of the Lias. It is highly probable that Tenison-Woods confounded this species with *P. pleuronectes* in his record of the occurrence of the recent species in the Mount Gambier limestone, as the only smooth pecten known to me to be found there is *P. Hochstetteri*.

Pecten lucens, *spec. nov.*

Shell nearly orbicular, slightly inequivalve, equilateral, a little gaping at each side below the ears, compressed, thin, pellucid, externally smooth but radially and concentrically striated under the lense; internally rayed with from 30 to 36 pairs of ribs. Right valve slightly convex from the umbo to the anterior margin; ears equal, straight, truncated, transversely striated and faintly radially ridged. Left valve depressed in the umbonal region; ears obliquely truncated, transversely striated, upper margin sometimes dentate; hinge area internally thickened, bearing at each anterior corner a subacute boss.

Dimensions.—Transverse and longitudinal diameters 48 millimetres; thickness through both valves 10 millimetres. My largest specimen measures 100 millimetres in the diameters.

Localities.—Oyster bed, Aldinga Bay; calciferous sandstone of the River Murray Cliffs at Blanchetown.

P. lucens differs from all living species of the group by the greater number of the internal radial ridges, and by the same character it is separable from the Chilian fossil species, *P. Darwinianus*, D'Orb., to which it bears a close resemblance.

Pecten Zitteli, *Hutton.* Pl. vii., figs. 3*a*—3*c*.

Reference.—Catalogue Tertiary Mollusca of New Zealand, p. 32, No. 118 (1873).

Synonym.—Pecten sp., *Zittel* in Palæontologie von Neu-Seeland, p. 53, t. 9, figs. 1*b* and 3, 1864.

Amusium Atkinsoni, *R. M. Johnston*, in Proc. Roy. Soc., Tasmania, 1880, p. 41.

Shell small, sub-orbicular, compressed, equilateral, equivalve. Interior of both valves concave, shining, with nine or eleven ribs which terminate truncatedly near the margin. Right valve reticulatedly striated or ridged; left valve concentrically striated; ears unequal. The exterior ornament of the right valve varies very much in respect of the number and thickness of the radial and concentric threads; usually the radial threads are stouter than the raised concentric lines, but this form merges on the one hand into a fenestrated ornament, and on the other to one in which the radial ridges are very prominent and minutely scaly. Ears of right valve unequal, the posterior larger and triangular, cancellate; anterior triangular, with concentric scaly lamellæ.

Digitized by Google

The left valve is invariably concentrically striated, the i terior ribs showing as faint dark lines, but may present smoothed surface from exfoliation of the external shell laye Ears very unequal, posterior the larger, aliiform, distantl arcuate-ridged and faintly rayed; anterior triangular, concer trically striated.

Dimensions of a large specimen.—Length, 10; height, 9 millimetres.

Localities.—Abundant in the Turritella-marls, Aldinga Ba glauconitic sands, Adelaide bore; Muddy Creek, Vict.; ga tropod bed, R. Murray cliffs.

Table Cape, Tasmania (*R. M. Johnston!*).

Several stations of the Ototara Group, New Zealan (*Hutton, op. cit.*).

Zittel's figures represent the interior with ten ribs; Hutto however, describes the interior with eleven ribs, and the e terior as smooth. Nevertheless, two impressions of rig valves from Waihao River in my possession, received from t Wellington Museum, show distinct traces of a fenestrate ornament between eleven radial lines indicating the intern ribs. I think it is clear that Hutton's diagnosis is based upo an excorticated specimen of a left valve, and that the Waih River specimens here referred to supply the desiderate characters necessary to establish specific identity betwee the very perfect Australian specimens and those on whi *P. Zitteli* has been founded.

In respect to *P. Atkinsoni*, Johnston, a left valve of which my possession, kindly communicated by the describer, is every respect identical with Australian specimens, I am i clined to the opinion that the dissimilar ornament of the rig valve has escaped his notice, and I have little hesitation referring it to *P. Zitteli.*

It is only at Aldinga and Adelaide that are found exampl of large dimensions equalling those of the New Zealand one The Table Cape and Muddy Creek specimens are usually le than half the size.

P. Zitteli recalls *P. personatus*, Zieten, of the Lower Jurass rocks of Europe; the Tertiary, *P. pygmæus*, Munster, seem to belong to the same type, which is unrepresented in livi creation.

Hinnites Corioensis, *McCoy.*

Ref.—Prodromus Palæontology of Victoria. Decade V pl. lviii.; 1879.

Localities.—Victoria—Extremely common at Corio Bay near Bairnsdale, on the Nicholson River (*McCoy*). Sout Australia—Glauconitic limestone of Aldinga Bay.

Digitized by Google

SYNOPSIS OF THE SPECIES OF THE

SUB-FAMILY LIMINÆ.

GENUS LIMA.

Radial ornament simple.	
Obliquely ovate, 25 to 30 ribs.	*L. Bassii.*
Ovate-trigonal, 70 ribs.	*L. polyactina.*
Radical ornament divaricate.	*L. linguliformis.*

SECTION LIMATULA.

Radial ribs prominent.	*L. Jeffreysiana.*
Radial striæ very numerous.	*L. polynema.*

GENUS LIMEA.

Ribs many, obtuse, interspaces cancellated.	*L. transenna.*
Ribs 14, interspaces striated transversely.	*L. alticostata.*

Lima Bassii, *Tenison-Woods.* Plate v., fig. 8; plate viii., fig. 1.

Reference.—Proc. Roy. Soc., Tasmania, for 1876, p. 112 (1877).

Shell obliquely subovate, somewhat compressed, rather solid, rayed with from 25 to 30 imbricately squamose ribs; margin full and equally rounded with a prolonged curve, post-dorsal side short and very slightly concave, almost margined through its whole extent by a small obtuse-angled auricle, which is radiately and squamosely ribbed; anterior side, with an obsolete auricle, truncated with a straight sloping line; lunule rayed with granular ribs. Umbos acute, and only slightly arched. Hinge line narrow, lateral margins of hinge area with a small denticle. The ribs vary much in number, irrespective of size of shell, as few as 21 and as many as 34 have been counted; they are usually flatly rounded with narrower interspaces, but specimens from the River Murray cliffs have subangular ribs; the interspaces are transversely striated or lamellate, or, as in the case of examples from the Lower Aldinga series, obliquely sculptured.

Dimensions of figured specimens.—Pl. 5., fig. 8, dorso-ventral diameter 31·5, lateral diameter 27, thickness through both valves 5 millimetres; pl. 8., fig. 1, the respective values are 30, 26, and 5. Diameters of largest specimen 41 and 33.

Localities.—Type-form with rounded ribs and transverse sculpture between. Table Cape (*R. M. Johnston!*); Muddy Creek (*R.T.*).

Var. a with subangular and transverse lamellæ between. Middle Murravian series near Morgan and Blanchetown (*R.T.*).

Var. b with flatly rounded ribs and oblique sculpture between. Glauconitic limestone, Aldinga Bay; glauconitic sands, Adelaide-bore (*R.T.*).

L. Bassii so closely approximates to *L. squamosa*, or the so-

Digitized by Google

named species of Australian seas, that it is with some hesit tion I venture to separate them. However, *L. Bassii* may distinguished by its flatter shell, less inflated beaks, less pr duced anteriorly, and by its narrower hinge line, whilst t ribs are usually more rounded and the anterior ear obsolete.

Taking two examples of about the same size, the followi measurements will formulate some of the above-mention differences:—

	L. Bassii	*L. squamosa*
Antero-dorsal diameter ...	41	39 millimetres
Lateral diameter	33	35 "
Breadth of hinge... ...	10	13 "

The New Zealand Older Tertiary species, *L. multiradia* and *L. paleata*, Hutton, are closely related to *L. Bassii*, but them the ribs are wider apart.

Lima polyactina, *spec. nov.* Pl. viii., figs. 4*a*—4*c*.

Shell minute, ovate-trigonal, ventricose, nearly equilatera lateral and ventral margins regularly convex, attenuated t wards the dorsal line, ornamented with numerous (about 7 depressed radial ribs, smooth or minutely-scaly, interstic narrower than the ribs, punctatedly impressed. Hinge li very short, almost wholly anterior; umbos erect, acut divergent; lunule-area deeply impressed; anterior auric minute, triangular, posterior obsolete.

Dimensions.—Ventro-dorsal diameter, 4; lateral diamete 6 millimetres.

Locality.—Adelaide bore, three examples (*R.T.*).

Lima linguliformis, *spec. nov.* Pl. iii., figs. 1*a*—1*b*.

Shell oval, sub-compressed, equivalve, almost equilatera valves gaping in front, ornamented with flattened, slight wavy, inconspicuous ribs which radiate from the longitudin centre-line; ribs obscurely granose-nodulose towards t ventral margin, the narrow interstitial furrows coarsely pun tated. Anterior auricle, with the outer margin thickened ar everted; posterior auricle obsolete.

Dimensions.—Ventro-dorsal diameter, 19; lateral diamete 15; thickness through both valves, 6 millimetres.

Locality.—Muddy Creek (*R.T.*); Schnapper Point, Po Phillip Bay (*R.T.*).

This fossil species is allied to *L. scabra*, Born., and *L. tener* Chem., by its divaricate sculpture, and approaches the latte in shape, but differs in its oval outline and imperfect posterio auricle.

Digitized by Google

Lima Jeffreysiana, *Tate.* Pl. iv., fig. 8.

ce.—Proc. Roy. Soc., Tasmania, for 1884, p. 230.

n.—*Lima subauriculata*, Tenison-Woods, Proc. Roy. ., for 1876, p. 113 (1877), (*non Montfort*).

hin, elongate-ovate, with nearly straight sides, sub- l by the slight obliquity of the hinge line, ventricose. rnamented with distant, acute, longitudinal ribs and undulate, concentric striæ; the rays are very con- n the middle and anterior parts, but become indis- ards the posterior border; the intercrossing of the os and the concentric striæ form blunt imbricating ; the concentric striæ merge into strong folds to- anterior border. Auricles of moderate size, equal, gular. Umbos elevately and acutely produced.

ons.—Length, 23; breadth, 15; thickness, 16 mills.

es.—Table Cape (*R. M. Johnston !*); Yorke Penin- nga, River Murray Cliffs, Mount Gambier; Muddy Schnapper Point, Hobson's Bay (*R. Tate*).

uriculata and *L. elliptica* differ from *L. Jeffreysiana* ibs, smooth sides, medial furrows, and more inflated Among recent Australian shells the fossil species s *L. Strangei*, from which it differs by its straighter ts more numerous and acute ribs, and by being more .

dedicated to Mr. Gwyn Jeffreys, F.R.S., the eminent ist, in acknowledgment of his help in its elaboration.

Lima polynema, *spec. nov.* Plate x., fig. 9.

in, ventricose, obliquely ovate; surface marked with numerous (about 90) radial threads and a few distant striæ.

ons. — Ventro-dorsal diameter, about 10; lateral about 7 millimetres.

.—Glauconitic sands, Adelaide bore.

erfect specimen only known, but is distinguishable cent and Tertiary species by its numerous simple eads and nearly straight sides.

imea transenna, *spec. nov.* Plate ix., figs. 6*a*—6*b*.

Cucullæa minuta, Johnston, Proc. Roy. Soc., Tas- 1879, p. 40 (1880).

mall, thin, obliquely subtrigonal; ventricose, at- in the dorsal region, expanded towards the ventral which is posteriorly obliquely produced. Umbos acutely produced. Valves closed, rayed with numer- e ribs, the interstitial spaces broader, granulated in e line, and cancellated by equidistant concentric striæ

Digitized by Google

interrupted by the radii. Auricles small, angular; hinge line narrow, with four or five longitudinal plications on each margin. Inner margin of valves crenulated.

Dimensions.—Ventro-dorsal diameter, 8·5; lateral diameter 6; thickness through both valves, 5.

Localities.—Muddy Creek, Hamilton; Mount Gambier, white polyzoal limestone (*R. T.*). Probably this species at Table Cape, Tasmania.

In this species the denticulations of the hinge are longitudinal and marginal; whilst in *L. alticosta* they are transverse and occupy the whole length of the hinge-line.

Mr. R. M. Johnston has described a shell under the name of *Cucullæa minuta*, op. cit., which from its description may be either *Limea transenna*, or conspecific therewith. He moreover states that it is not unlike *Limatula subauriculata* [*L. Jeffreysiana*] in general appearance. I transcribe its diagnosis:—"Shell very minute, thin, obliquely oval; hinge-line straight narrow, with three or four teeth, oblique at extreme corners surface of valves ornamented with fine radial ridges, and crossed by lines of growth; towards the margin the ridges are lamellar, and are also imbricated where intersected by the concentric lines of growth; margin finely crenulate; long. 3 mil., lat. 2½ mil., thickness at umbo of both valves 1½ mil. Rare, Table Cape."

Limea alticosta, *spec. nov.* Plate iii., fig. 8.

Shell minute, shortly oval, slightly inequilateral, dorsal line short, straight; umbo central, elevated, obtusely produced; auricles small, unequal. Rayed with 14 elevated subacute ribs narrower than the interspaces, faintly striated transversely. Hinge margin with from six to seven transverse denticles on each side of the ligamental socket. Ventral margin strongly crenate.

Dimensions.—Length and height exceeding two millimetres.

Locality.—Adelaide bore (one ex.).

This species resembles the type of the genus, *L. Sarsi*, but is more inequilateral and has plain ribs; its similarity to *L. acuticosta*, Munster, of the European Lias is very striking from which it differs externally by its less oblique shape, while the hinge teeth of that species are longitudinal on the outer margins, and not transverse throughout the cardinal line.

FAMILY SPONDYLIIDÆ.

Genus Spondylus.

SYNOPSIS OF SPECIES.

Finely ribbed between the primary ribs. *S. pseudoradula*
Coarsely ribbed between the primary ribs. *S. gæderopoides*

Digitized by Google

Spondylus pseudoradula, McCoy.

Reference.—Prodromus Pal. Victoria, Decade v., pl. 45, fig. 2 (1877).

Localities.—Victoria: clays near Mount Martha in Port Phillip Bay; claybeds of Muddy Creek; at Fyansford, Bairnsdale, and Mordialloc (*McCoy*).

South Australia: common in the calciferous sandstones of the River Murray Cliffs (*R.T.*).

Spondylus gæderopoides, McCoy.

Reference.—Prodromus Pal. Victoria, Decade iv., pl. 38 (1876); Dec. v., pl. 45, figs. 1 and 3.

Localities.—Victoria: sandy strata of Bird Rock Bluff, near Geelong; in the cream-colored limestone of Boggy Creek, six miles from Sale, Gippsland (*McCoy*).

South Australia: glauconitic limestone and Turritella limestone bands at Blanche Point, Aldinga Bay; in the glauconitic clayey sands, Adelaide bore; in the chalk rock of the Bunda Cliffs, Great Australian Bight (*R.T.*).

FAMILY AVICULIDÆ.

Avicula nasuta, *spec. nov.* Pl. xi., fig. 11; pl. xii., fig. 12.

The aviculid represented on pl. xi., fig. 11, is the best of the few specimens that have come under my observation; it is not only imperfect, but has lost its external shell layer, and a complete diagnosis of the characters is not possible. The figured specimen is a right valve, incorrectly shown as a left valve. However, a fragment illustrated by fig. 12, pl. xii., is complete so far as regards the umbo and anterior wing, the disproportionate length of the latter part in conjunction with the shape of the valve seem to afford specific characters.

Dimensions.—Length, about 40; width, about 20 millimetres.

Locality.—Adelaide bore, in brown clayey sand with glauconitic grains.

Meleagrina crassicardia, *spec. nov.* Pl. ix., figs. 9 and 10.

Shell slightly oblique, roundly quadrate, inequivalve, very inequilateral, left valve moderately tumid, right valve flatter. Hinge-line long, straight, with a distinct cardinal tooth in the young shell; the ligamental area very broad, and flattened externally, cardinal tooth obsolete in the adult. Anterior auricle of the left valve short, tumid, and acutely pointed, that of the right valve depressed, slightly emarginated below at the narrow byssal fissure; posterior wing small but distinctly developed, acutely pointed. The surface shows indistinct, distant striæ of growth, but to the unaided eye appears smooth.

Digitized by Google

Dimensions.—Young example, pl. ix., fig. 9. Length of hinge, 37; greatest length measured from umbo to the post-ventral margin, 37 millimetres. Average-sized adult specimens measure about 60 millimetres in the transverse diameters.

Localities.—Muddy Creek, Hamilton (young examples only); oyster-beds, North-west Bend Head Station, near Morgan, on the River Murray (adult examples only). *R. T.*

Vulsella lævigata, *spec. nov.* Plate iii., figs. 3*a*—3*b*.

Right valve narrow oblong, attenuated dorsally and rounded ventrally, posterior side nearly straight, anterior side somewhat arched; greatest width in the dorsal-third; umbo a little swollen and elevated, not divergent from the hinge. Surface irregularly concentrically lamellose, especially in the umbonal region. Hinge-line short; but the ligamental socket proportionately long, triangular, erect.

Dimensions.—Length 11, height 29 millimetres.

Locality.—Glauconitic limestone at the base of Witton Bluff, near mouth of the River Onkaparinga.

By the absence of crenulated striæ or scales, and by its form it approximates to *V. deperdita* of the European Eocene, but that shell is broader with diverging umbos; its resemblance to *V. angustata*, Deshayes, of the Parisian Eocene is very close from which the present species differs by the large, straight ligamental pit.

Perna, *sp. ind.*

Locality.—Witton Bluff, at the mouth of the River Onkaparinga. A cast of a large species apparently identical with an undescribed species from the "Trelissick Group," New Zealand.

SUB-FAMILY PINNIINÆ.

GENUS PINNA.

Valves convex, longitudinal ribs with erect scales. *P. semicostata*

Valves acutely angulated, longitudinal ribs without scales. *P. sp*

Pinna semicostata, *spec. nov.* Plate xii., fig. 9.

Triangular, elongate, slightly sinuated at the byssal region valves very convex with abrupt sides, the dorsal half with rather close obsolete longitudinal ribs (about ten) raised into close short semi-cyclindrical scales; the ventral half with strong concentric folds.

Dimensions.—Length of dorsal margin 130, width 65 greatest thickness through both valves 43 millimetres.

Localities.—Oyster banks, Adelaide and Aldinga Bay.

Digitized by Google

pecies has a general resemblance to *P. Zealandica*, om which it differs by the longitudinal scaly ribs being to the dorsal surface, and by its much greater con-

Pinna, *sp. indet.*

portions only known. Valves acutely angulated, t longitudinal ribs separated by broad interspaces on al slope, crossed by undulose ridges.
rous sandrock, River Murray cliffs, near Morgan.

FAMILY MYTILIDÆ.

Genus Modiola.

vate-oblong, inflated. *M. Adelaidensis.*
longated, inflated. *M. sp.*
longated, compressed. *M. sp.*

Modiola Adelaidensis, *spec. nov.* Pl. xi., fig. 3.

oblong, with inflated subterminal beaks, the anterior narrow and obtuse; the post-dorsal portion is dilated mes gradually flattened, the ventral side is compara- arrow and convex. Posterior margin broadly sub- dorsal margin slightly curved, ventral margin straight, margin rounded, projecting beyond the umbo. Surface l-defined concentric folds of growth.
sions.—Greatest length, 28; greatest width at right longitudinal diameter, 18; greatest thickness through es, 13 millimetres.
y.—Glauconitic sands, Adelaide bore.
ssil species has some resemblance to certain individual of the recent *M. flavida*, but is distinguished by the d less anterior umbones.

Modiola, *sp. indet.*

r to the last, but longer and narrower; the single known is unfortunately somewhat crushed.
, 43; breadth, 17 millimetres.
y.—Glauconite sands, Adelaide bore.

Modiola, *sp. indet.*

pressed elongate shell, with nearly terminal beaks, is by casts in the calciferous rocks on the River and at Salem, near Callington, on the River Bremer.
, 55; breadth, 20; thickness through both valves, 13 es.

Digitized by Google

Lithodomus, *sp. indet.*

Casts and crypts of a *Lithodomus* in the coral *Plesiastræa Vincenti* occurring at Hallett's Cove indicate a short tumid shell with broad incurved beaks, the anterior end slightly convex, the posterior obliquely obtuse.

Length, 21; breadth, 10; thickness through both valves, 11 millimetres.

Genus Mytilus.

Shell cylindrical tumid.	*M. sp.*
Shell subquadrangular.	*M. subMenkeanus.*

Mytilus, *sp. indet.*

An imperfect specimen of a cylindrical tumid mussel, finely longitudinally striated on the steep ventral slope, has been obtained from the glauconitic limestone at Blanche Point, Aldinga Bay. Length 47, width 15 millimetres.

Mytilus subMenkeanus, *spec nov.*

A complete diagnosis is impossible from the fragmentary state of the specimens, which, however, indicate a species of the general form of the recent *M. Menkeanus*, but with fewer and stouter longitudinal ribs.

Locality.—Hallet's Cove, on the horizon of the oyster banks at Aldinga Bay.

Septifer fenestratus, *spec. nov.* Pl. ix., fig. 1.

Shell elongate-triangular, very inequilateral, equivalve; umbos almost marginal, subacute, curved; anterior side nearly straight, slightly outwardly convex about the middle, rising abruptly to the elevated rounded umbonal ridge; dorsal line straight; post-dorsal area depressed, its margin making an obtuse angle (about 120°) with the dorsal line; ventral margin attenuated, rounded; byssal sinus inconspicuous. Surface ornamented with numerous divaricate subacute ribs, the interspaces shallow, concave, broader than the radial ribs, latticed by stoutish raised lines; also by distant imbricating folds of growth. Hinge thickened anteriorily with a small umbonal shelf (umbonal cavity is filled up at the senile stage of growth); ligamental groove linear, slightly obliquely extending posteriorly; the whole inner margin of the valves crenulated, the crenulations on the hinge line becoming denticulate, and three or four beneath the umbo are much larger than the rest.

Dimensions.—Length of hinge-line, 9·5; antero-dorsal to post-ventral margins, 16; thickness through both valves, 8 millimetres. An unusually large specimen has the first two dimensions respectively 28 and 44 millimetres.

Localities.—Muddy Creek; Corio Bay; Schnapper Point, Hobson's Bay, Victoria (*R. T.*).

Digitized by Google

This Australian fossil *Septifer* proves to be distinct from its congeners. So far as I have been able to make comparisons, it approaches *S. denticulatus*, Lamk., but differs in its high rounded umbonal ridge and its latticed ornament.

GENUS MODIOLARIA.

SYNOPSIS OF SPECIES.

Shell obliquely ovate-oblong. *M. singularis.*
Shell oblong, very inflated, acutely truncated behind. *M. arcacea.*
Shell oblong, moderately inflated, roundly truncated.
Depressed anterior area without rays. *M. semigranosa.*
Depressed anterior area with twelve acute ribs. *M. Corioensis.*

Modiolaria singularis, *spec. nov.* Pl. iii., fig. 7.

Shell obliquely ovate-oblong, equivalve, inequilateral, thin, translucent; umbos large, obtuse, approximate, a little anterior. Surface finely concentrically striated; umbonal ridge obscurely radially lined. Hinge line crenulated, rest of inner margin plain, except post-ventrally, where it is thickened and crenulated, the crenulations corresponding with the radial lines, which are more conspicuous internally than externally.

Dimensions.—Length, 2·5; height, 3; thickness through both valves, 3 millimetres.

Locality.—Muddy Creek, a single perfect shell (*R. T.*).

Though the form approximates to *Crenella*, yet as the hinge characters are proper to *Modiolaria*, I prefer to place it there, despite its abnormal shape and ornamentation.

Modiolaria arcacea, *spec. nov.* Pl. ix., figs. 2*a*—2*b*.

Shell oblong, umbos marginal, very inflated, incurved, somewhat wide apart; anterior margin rounded, obliquely truncated posteriorly, dorsal line slightly arched; posterior area flattened, defined by a prominent umbonal ridge. Anterior radial area narrow, ribs rounded, crossed by lamellæ; posterior radial area extending over the umbonal ridge, rayed with flat ribs about as wide as the depressed interspaces, the whole crossed by equidistant lamellæ.

Dimensions.—Length, 27; height, 12; thickness through both valves, 18 millimetres.

Locality.—Turritella grits at Ardrossan (*O. Tepper*).

Modiolaria semigranosa, *spec. nov.* Pl. iii., fig. 5.

Shell oval-oblong, sub-diaphanous; umbo sub-marginal, rather depressed; anterior radial area obsolete, posterior radial area with sub-acute ribs about as broad as the inter-

Digitized by Google

spaces; ribs obsoletely granulo-nodulose, except on the flat tened area posterior to the regularly rounded umbonal ridge where they are covered by depressed imbricating lamellæ inner margin of valve crenulated, denticulate under the umbo

Dimensions.—Length, 7; height, 4·5 millimetres.

Locality.—Adelaide bore. A left valve (*R.T.*).

Modiolaria Corioensis, *spec. nov.* Pl. iii., fig. 4.

Shell oval-oblong, sub-diaphanous; umbo almost marginal somewhat depressed, medial smooth area about two-thirds o the length of the shell; anterior radial area with about twelv acute ribs narrower than the angular interspaces; posterio radial area with about 30 flat ribs with linear interspaces Inner margin of valve crenulated, denticulate under the umbo

Dimensions.—Length, six; height, four millimetres.

Locality.—Corio Bay, Victoria (*R.T.*).

M. Corioensis is closely related to *M. impacta*, Hermann, and *M. Cumingiana*, Dunker; from the first it differs by its fine and numerous radii, and from the latter in being less gibbou and by its wider medial area.

Two other species of *Modiolaria* have been collected from the oyster banks of the Aldinga cliffs, but in a too exfoliated condition for diagnosis.

Crenella globularis, *spec. nov.* Pl. x., figs. 3*a*—3*b*.

Shell small, thin, translucent, sub-globose, pearly within equivalve, inflated especially in the dorsal third; umbos a littl anterior, obtuse, incurved, approximate; surface regularly cancellated; ligamental groove internal, lanceolate, extending posteriorly; hinge line bordering the ligamental area, minutely transversely denticulated; a small denticle terminates the ligamental groove under the umbo; margin of valves crenu lated all round.

Dimensions.—Length, 5; height, 6; thickness through both valves, 7 millimetres.

Localities. — Glauconitic sands, Adelaide bore, many examples; gastropod bed, near Morgan, one example; Muddy Creek, Hamilton; Table Cape, one example (*R.T.*).

This fossil differs only specifically from *Stalagmium margaritacea*, Conrad=*Myoparo costatus*, Lea, of the Eocene of Alabama, which it resembles more than any other congener known to me; it is distinguished by its spherical shape and cancellated ornament. *C. elegans*, Deshayes, of the Parisian Eocene, is another closely related species.

Digitized by Google

FAMILY ARCADÆ.

SUB-FAMILY NUCULINÆ.

Genus Nucula.

SYNOPSIS OF SPECIES.

Shell smooth, margin not crenulated.	*N. tumida.*
Shell concentrically ridged and radially striated, margin crenulated.	
Obliquely trigonal, folds thin.	*N. Atkinsoni.*
More oblique, folds thick.	*N. semistriata.*
Trigonal, equilateral.	*N. Morundiana.*
Shell with fenestrated ornament.	*N. fenestralis.*

Nucula tumida, Tenison-Woods. Pl. vi., figs. 6*a*—6*b*.

Reference.—Proceedings Royal Soc., Tasmania, for 1877, p. iii.

Shell solid, obliquely trigonal, tumid, truncated posteriorly, slightly produced and rounded anteriorly, wrinkled with consecutive irregular, flattened folds of growth, increasing in thickness from the umbos to the margin; margin acute. Hinge teeth diverging progressively in an increasing series, interrupted by a narrow deep ligamental pit, which is obliquely produced posteriorly; the teeth are lanceolate, high, and lamellar, the distal ones smaller; in the posterior row there are eight, and in the anterior row about thirty. Umbos acute and sharply incurved; lunule shallow, but well defined, wrinkled and broadly lanceolate.

Dimensions.—Length, 21; height, 16; thickness through both valves, 14 millimetres.

Localities.—Tasmania: Table Cape (locality of the type) (*Tenison-Woods* and *R. M. Johnston!*).

Victoria: Muddy Creek, Hamilton (common and large); Corio Bay, Geelong; Schnapper Point, Port Philip.

South Australia: Gastropod bed, Middle Murravian, near Morgan (*R.T.*)

The author of this species states that it is "not unlike the Tasmanian *N. Grayii*, Sow., but is more tumid and conspicuously sulcate," distinctions which I confirm.

Nucula Atkinsoni, *R. M. Johnston.* Pl. iv., fig. 3*a*—3*c*.

Reference.—*Portlandia Atkinsoni*, R. M. Johnston, in Proc. Roy. Soc., Tasm., vol. for 1880, p. 39.

Shell small, obliquely trigonal, subdepressed; the very short posterior slope truncated. Surface of valves concentrically finely ridged; the ridges increase in size, and frequently anastomose towards the centre and margin, and are traversed

Digitized by Google

by fine radial threads, which form an open tessellated sculpture. Umbos sharply incurved; lunule shallow (scarcely defined), broadly lanceolate; ligamental pit inconspicuous; cardinal teeth lamellar, eight on the posterior and about 20 on the anterior slope. Edge of the ventral half of the valves minutely crenulated.

Dimensions.—Length, 7·5; height, 6·5; thickness through both valves, 4 millimetres.

Localities.—Table Cape, Tasmania (*R. M. Johnston*); Gastropod bed of the Middle Murravian, near Morgan (*R. T.*); Corio Bay, Geelong (*R. T.*).

The radial sculpture is not always visible by the aid of a pocket-lens, but the crenulated margin and the radial lines which proceed from it towards the interior are always discernible.

This shell has been wrongly placed in *Portlandia*, which is a *Yoldia* having the valves posteriorly closed, whilst it has the simple pallial line and other characters proper to *Nucula*.

Nucula semistriata, *spec. nov.* Pl. iv., figs. 5*a*—5*b*.

Shell small, obliquely trigonal, moderately depressed; the very short posterior side roundly truncated; anteriorly produced and rounded at the extremity. Surface with depressed folds of growth, somewhat retroflexed, the folds increasing in size, and here and there anastomising, towards the front where the interspaces are conspicuously radially ridged; posterior and anterior slopes radially striated. Umbos rather elevated, sharply recurved, lunule inconspicuous. Edge of valves crenulated. Ligamental pit scarcely defined.

Dimensions.—Length, 5·5; height, 4·25; thickness through both valves, 3 millimetres.

Localities.—Turritella clays, Blanche Point, Aldinga Bay; glauconite sands, Adelaide bore (*R. T.*).

This species differs from *N. Atkinsoni* by its greater obliquity and the thick retroflexed folds.

Nucula Morundiana, *spec. nov.* Pl. iv., figs. 2*a*—2*b*.

Shell minute, tumid, solid, trigonal, equilateral; posterior side obscurely angled and flattened above; anterior side obtusely rounded; umbones obtuse; surface ornamented with regular, equal rounded, concentric ribs, and microscopic radial striæ; inner margin of valves minutely denticulated.

Dimensions.—Length and height 3, thickness through both valves 2 millimetres.

Localities.—Muddy Creek, Hamilton, and the calciferous sandstones of the River Murray-cliffs near Morgan.

Digitized by Google

The specific name is derived from the aboriginal name of the Lower Murray River.

This minute shell is not the young of *N. Atkinsoni*, and differs from *Leda lucida*, T. Woods, by the equality of the transverse diameters of the valves.

Nucula fenestralis, *spec. nov.* Pl. iv., fig. 4.

Shell minute, ovate-oblong, somewhat tumid, umbo in the posterior-third; the shorter posterior side with a rounded margin; the anterior side roundly truncated. Surface ornamented by equidistant and equal-sized radial and concentric ribs; edge of valve crenulated.

Dimensions.—Length about 2, height about 1¼ millimetres.

Locality.—Table Cape, Tasmania (*R. T.*).

The peculiar feature of this fossil is the subcentral umbo and the gross cancellated sculpture.

GENUS LEDA.

SYNOPSIS OF SPECIES.

A. Non-rostrated; ovate-quadrate.	*L. obolella.*
More circular and depressed.	*L. planiuscula.*
B. Rostrated.	
Elongately-lanceolate.	*L. Huttoni.*
Elongately-oval.	*L. acinaciformis.*
Ovate-trigonal or pyriform	
Gradually acuminately-rostrated.	*L. apiculata.*
Abruptly rostrated and compressed.	*L. leptorhyncha.*
Oblong-ovate.	*L. lucida.*
Transversely-ovate, posterior side the shorter.	*L. prælonga.*
Rostral prolongation, biangulate.	
Oblong-subovate.	*T. Woodsii.*
Ovate-trigonal.	*L. crebricostata.*

Leda obolella, *spec. nov.* Pl. v., figs. 3*a*—3*b*.

Shell small, thin, ovate-quadrate, slightly inequilateral, depressed; umbos very small, slightly recurved, almost central; dorsal margin regularly sloping, anterior margin roundly truncate, the antero-dorsal area slightly depressed; posterior margin rounded, surface faintly concentrically striated; lunule obsolete; hinge teeth small, curved, about 15 on each side of a rather broad, erect, triangular cartilage pit.

Dimensions.—Length, 11·5; height, 9·5; thickness through both valves, 4 millimetres.

Localities.—Not uncommon at Muddy Creek; Schnapper Point; gastropod bed, Middle Murravian, near Morgan (*R.T.*).

This fossil differs from all living species, but has some re-

Digitized by Google

semblance to some species of *Yoldia;* it, however, does not belong to that genus, as the valves are closed, and the pallial sinus is small. It recalls some of the Jurassic species, notably *L. subovalis*, Goldfuss, of the European Lias.

Leda planiuscula, *spec. nov.* Pl. v., fig. 2.

Shell minute, similar to *L. obolella:* comparing equal-sized specimens of each, *L. planiuscula* is more depressed, and the outline approaches more to the circular.

Dimensions.—Length, 5; height, 4·5 millimetres.

Locality.—Adelaide bore.

Leda Huttoni, Tenison-Woods. Pl. vi., fig. 4.

Reference.—Proc. Linn. Soc., N.S.W., vol. iii., p. 239, tab. 21, fig. 2, 1878.

Shell small, depressed, thin, fragile, shining, transversely elongate, pyriform, concentrically irregularly striate and broadly sulcate, radially finely striated; posterior side much produced and slightly obliquely truncated at the end; obtusely triangulated. Anterior side short, rounded. Cardinal teeth numerous, minutely angular.

Dimensions.—Length, 11; height, 5 millimetres.

Localities.—Muddy Creek, Hamilton, where it is common!; Table Cape!; Adelaide bore; and Turritella clays, Aldinga (*R.T.*).

The specimens from Adelaide and Aldinga are a little more inflated, and the anterior side shorter, whilst the post-dorsal margin is sloping and not elevated at the end; the arched rostral prolongation is very conspicuous in young shells from Muddy Creek, but the character is not constant.

Leda acinaciformis, *spec. nov.* Pl. v., figs. 6*a*—6*b*.

Shell depressed, elongate-oval; umbo subcentral; anterior side rounded; dorsal margin sloping anteriorly, and slightly elevated at the posterior end; ventral margin strongly arcuate, curved upwards posteriorly to form a rostral prolongation. Umbonal ridge well defined, above which is a narrow lanceolate area. Surface sculptured with concentric, thick, flattened ribs. The regular convexity of the anterior surface is interrupted by a narrow, flattened, triangular area extending from the umbo to the antero-ventral margin, rendered conspicuous by the interrupted curve of the concentric ribs. Lunule lanceolate, longitudinally ridged.

Dimensions.—Length, 17; height, 8; thickness through both valves, 6 millimetres.

Locality.—Muddy Creek.

L. acinaciformis has the general form and ornament of

Digitized by Google

L. crassa, Hinds, its nearest ally in recent creation, from which it differs in its depressed elongated shape.

Leda apiculata, *spec. nov.* Pl. ix., figs. 4*a*—4*b*.

Shell ovate-subtrigonal, ventricose, inequilateral; umbo moderately inflated, rounded, recurved, in the anterior half. Anterior side inflated, rounded; ventral border arched, posterior side shortly acuminately rostrated; antero-dorsal margin sloping, post-dorsal area depressed, slightly elevated at the end. Whole surface marked with concentric raised threads narrower than the interspaces. Lunule well defined, striated; cardinal teeth about fifteen on each side of a small triangular ligamental pit.

Dimensions of figured specimen.—Length, 9·5; height, 5·5; thickness, 4 millimetres; of a larger example the longitudinal and transverse diameters are 11 and 6·5 millimetres respectively.

Localities.—Abundant in the Turritella clays at Blanche Point, Aldinga Bay; also in the glauconite sands, Adelaide bore; Muddy Creek and Schnapper Point, Victoria.

Leda leptorhyncha, *spec. nov.* Pl. x., figs. 5*a*—5*b*.

Shell minute pyriform, subventricose, much inflated in the middle; umbos subcentral, slighty elevated and recurved. Anterior side rounded, with the dorsal margin sloped; ventral border arched very abruptly sloping upwards posteriorly; posterior side a little the longer, much compressed, and acuminately rostrated above. Surface marked with concentric ridges and striæ, more or less obsolete on the beak. Lunule narrow lanceolate. Cardinal teeth, about 15 on each side of a small but well-defined triangular cartilage pit.

Dimensions.—Length, 5; height, 3; thickness through both valves, 2 millimetres.

Localities.—Turritella marls, Aldinga Bay; glauconite sands, Adelaide bore. Very common.

This species is not the young of *L. apiculata*, from which it differs by the contraction and compression beneath the rostrum, by its irregular sculpturing, and by its shape. Examples of *L. apiculata* of the size of the present species differ from the adult only by the post-dorsal side being straight, not elevated at the end.

Leda lucida, Tenison-Woods. Pl. vi., figs. 7*a*—7*b*.

Reference.—Proc. Linnean Soc., N.S.W., vol. iv., p. 3, t. 1, fig. 5 (1879).

Shell thick oblong, subventricose, umbo almost central, depressed, very slightly recurved; dorsal margin sloping an-

Digitized by Google

teriorly; anterior side rounded; ventral margin rather straig in the middle, abruptly sloping upwards posteriorly; poster side somewhat angular, shortly acuminate above. Surfa marked with concentric folds and striæ of growth. Lunu well-defined, elliptical, striated; cardinal teeth, 20 in front ro 15 in the posterior row.

Dimensions.—Length, 18; height, 11; thickness through bo valves, 8 millimetres.

Localities.—Corio Bay; common at Muddy Creek; Schnapp Point; and near Morgan (*R. T.*)

L. lucida was established upon a minute shell, which I ha been enabled to trace through various stages of growth to t moderately large-sized example figured on pl. vi., fig. 7. T original diagnosis reads as follows:—"Shell small, tumid, sol polished, equilateral, almost ovate, regularly concentrica ribbed; ribs rounded equal; posterior side scarcely produc subacutely angular, posterior angle scarcely sulcate; anter side short, obtusely rounded, umbone subacute. Long. 8 lat. 5·5, alt. 2 millimetres. Muddy Creek."

Professor McCoy, in Rep. Geol. Surv. Victoria, 1875, p. 1 figures the cast of a shell obtained at Stawell, which he sa "is the *Nucula Marthæ* (McCoy), an extinct species comm in the Oligocene Tertiary beds between Mount Eliza and Mou Martha." I have no doubt that the *N. Marthæ* above referr to is conspecific with *L. lucida*, though of the many examples all stages of growth from that particular locality which I ha examined, I cannot find one to match the drawing in the Ge Surv. Report. The drawing may imperfectly represent t shell; however, as it does not serve for identification, and no diagnosis has been published of the species, I prefer to e ploy the name given by Tenison Woods.

Leda prælonga, *spec. nov.* Pl. xii., figs. 4*a*—4*b*.

Shell small, transversely ovate, very inequilateral, rath compressed, smooth, shining; umbones post-median, inco spicuous; anterior side ventricose, rounded, produced; po terior side short, rather attenuated and bluntly acuminat valves closed; pallial sinus conspicuous.

Dimensions.—Length, 4; height, 2; thickness through bo valves, 1 millimetres.

Localities.—Table Cape, Tasmania; and Muddy Cree Hamilton, Victoria.

This is a very distinct species, and cannot be mistaken f young examples of associated species; it makes some approa to *L. leptorhyncha*, but differs from it by its shape and t position of its inconspicuous umbones.

Digitized by Google

Leda Woodsii, *spec. nov.* Pl. ix., fig. 8.

Synonym.—*L. inconspicua*, Tenison-Woods, in Proc. Linn. Soc., N.S.W., vol. iii., p. 139, t. 21, fig. 3, 1878 (*non* A. Adams).

Shell small, compressed, oblong subovate; umbos post-median, small, depressed; posterior side rather longer than the anterior side, obtusely truncated and acuminated at the end; anterior side rounded, somewhat attenuated; dorsal margin sloping anteriorly, nearly straight posteriorly. An angular posterior ridge originating at the umbo circumscribes a triangular depressed area. Surface finely concentrically ribbed, less conspicuously so on the anterior side; the ribs pass over the umbonal ridge on to the depressed area above. Lunule ill-defined, narrow elongate; ligamental pit triangular, deeply sunk.

Dimensions.—Length, 12; height, 6; thickness through both valves, 3·5 millimetres.

Localities.—Muddy Creek, Hamilton (*Ten. Woods!*); gastropod bed, Middle Murravian, near Morgan (*R.T.*).

The Rev. J. E. Tenison-Woods figures a young shell of this species under Adams' name of *L. inconspicua*. Certainly it closely resembles Reeve's figure of that species, but at later stages of growth the resemblance ceases, and the general form is that of *L. Dorhnii*, Hanley. Without specimens it would not be possible, I think, to differentiate the fossil from the living species above named; but the result of an actual comparison of specimens is that the fossil differs in the following particulars:—Hinge line more arched, anterior side more attenuated, the concentric ridges more numerous and finer.

Young examples of *L. Woodsii* differ from *L. crebrecostata*, Woods, in being more oblong and with finer concentric ridges, both agreeing in the short triangulated rostral prolongation.

Leda crebrecostata, Tenison-Woods. Pl. v., figs. 5*a*—5*b*.

Reference.—Proc. Royal Soc., Tasmania, vol. for 1877, p. .

Shell small, moderately depressed, transverse trigonal, narrowly oblong; umbo post-median; anterior side the longer roundly obtuse, posterior side shortly rostrated, triangular, rather compressed and obtusely truncated at the end. Surface regularly concentrically ridged with equal rounded ribs.

"Hinge line inconspicuous and short, anterior subligamental area distinct.

"Transverse length, 5; breadth, 8; thickness of both valves joined, 3 millimetres" (*T. Woods*).

Locality.—Table Cape (*R. M. Johnston!*).

It is smaller and less oblong than *L. Dohrnii*, Hanley, but like it distinguished by the abrupt angulation of the posterior margin and the concentric thick rounded ridges.

Digitized by Google

SUB-FAMILY PECTUNCULINÆ.

Genus Limopsis.

SYNOPSIS OF SPECIES.

Smooth or concentrically wrinkled, radial lines absent
not prominent.
Elongate-ovate, no radial ornament. *L. insoli*
Ovate-orbicular; thick, concentrically ridged, and fine
radiately striated. *L. auri*
Radial ornament prominent.
Radial ribs simple; cancellate. *L. Belche*
Radial ribs bifurcate; strong concentric folds.
L. multiradia

Limopsis insolita, *G. B. Sowerby.*

References.—*Trigonocælia insolita*, Sow. in Darwin's Ge
Obs. on S. America, 1846; p. 608, t. ii., figs. 20-21., 2nd e
Limopsis insolita, Zittel in Voy. Novara, Palæont., p. 4
t. xiii., fig. 1, 1864; *id.*, Hutton, Cat. Tert. Moll. of New Zealan
p. 28, 1873.

Localities.—South Australia: in a black clayey sand
the base of the sea cliff, half mile north of jetty in Aldin
Bay, very abundant; in a similar bed, Adelaide bore. N
Zealand: Pareora Series, at Nelson, Kaniera, Waik
(*Hutton*); also Santa Cruz, Patagonia (*Darwin*).

Limopsis aurita, *Brocchi.*

References.—*Arca aurita* (Br.), Conch. Foss. Subapennin
t. xi., fig. 9. *Limopsis aurita*, McCoy, Prodr. Pal. Victor
Dec. II., t. xix., figs 5-7 (1875).

Synonym.—*Limopsis Zealandica*, Hutton, Cat. Tert. Mol
N.Z., p. 28 (1873).

Localities.—Victoria: At Bird-rock Point, near Geelon
at Schnapper Point and at Mornington, Port Phillip (*McCo*
Muddy Creek (*R. T.*). Tasmania: Table Cape (*R. M. Joh
ston*). Also fossil in European Miocene and Pliocene, a
recent in the Arctic and Southern Oceans.

Limopsis Belcheri, *Adams* and *Reeve.*

References.—*Pectunculus Belcheri*, Adams and Reeve, in Vo
of the Samarang, t. xxii., f. 5, p. 76 (1850). *Limopsis Belche*
McCoy, Prodv. Pal. Victoria, Dec. II., t. xix., figs. 8-9 (1875)

Localities.—Victoria: Balcombe Bay!; Muddy Creek
Moorabbin; Corio Bay; and west of mouth of Gellibra
River (*McCoy*). South Australia: Calciferous sandsto
near Morgan on the River Murray; raggy limestone at Edi
burg, Yorke Peninsula. Recent off the Cape of Good Ho

Digitized by Google

(Samarang Exped.); St. Vincent Gulf, Guichen Bay, and Portland, Southern Australia.

Limopsis multiradiata, *spec. nov.* Plate xii., figs. 1*a*—1*b*.

Shell ovate-orbicular, slightly inequivalve and oblique, thick, convex; umbones prominent, concentrically irregularly folded and radially ribbed; ribs thin, very numerous, narrower than interspaces, bifurcating at about the middle; cartilage pit large, equilateral, three or four very small teeth under it, six or seven larger ones on each side.

Dimensions.—Length from umbo to the post-ventral margin, 9.5; greatest width, 10; thickness through both valves, 5 millimetres.

Localities.—Glauconite argillaceous sands, Adelaide bore; and Turritella limestone bands, Blanche Point, Aldinga Bay.

Among the Australian congeners this species resembles *L. aurita*, somewhat in shape though less oblique, and the undulating folds are thick and irregular. The conspicuous radial ribs ally it to *L. Belcheri*, which is distinguished by a peculiar style of tesselated sculpture produced by wavy concentric fringes; in *L. multiradiata* the radial ribs bifurcate, and only in young shells is there present a fenestrated ornament produced by the crossing of simple concentric threads.

LIMARCA, *gen. nov.*

Derivation from Lima and Arca. Type, L. angustifrons, spec. nov.

Very inequilateral; cartilage pit lanceolate, excavated on the hinge line, directed backwards; hinge line with anterior denticles and posterior elongated longitudinal teeth. No area under the umbo.

L. iniquidens, Sanberger, in Die Conchylien des Mainzer Tertiarbeckens, 1863, p. 347, t. 29, fig. 5, is apparently congeneric.

The characters of the cardinal region recall *Crenella* in Mytilidæ, but the muscular impressions determine its place in Arcadæ, whilst its similitude to *Limopsis* is great. It agrees with *Trigonocœlia* in the absence of an area between the umbo and the hinge line, and in this particular differs from *Limopsis* and *Cyrilla*; from *Trigonocœlia* it differs by the fewness of the cardinal teeth, the posterior of which are longitudinal and not cross-set.

Limarca angustifrons, *spec. nov.* Plate viii., figs. 5*a*—5*b*.

Shell small, subrhomboidal, convex, equivalve, very inequilateral; anterior margin regularly rounded; posterior roundly truncated; ventral margin regularly convex outwardly. Sur-

Digitized by Google

face ornamented with broadish depressed transverse and narrow radial ribs. Umbones minute, subterminal, obtuse; no area; hinge-line thick, obtusangular; ligamental pit excavated in the hinge-line, oblique, lanceolate, directed backwards; anterior to the pit are three suberect denticles, and posteriorly four longitudinal teeth. Internal margin of valves crenulated, more prominently so in the posterior part.

Dimensions.—Length from umbo to post-ventral margin, 5·5; width, 5·5; thickness through both valves, about 4 millimetres.

Localities.—Turritella-beds, Blanche Point, Aldinga Bay, and glauconitic argillaceous sands, Adelaide bore.

This species has a general resemblance to *L. iniquidens*, Sandb., but wants the auriculated antero-dorsal margin, and has fewer hinge teeth.

Genus Pectunculus.

synopsis of species.

I. Finely radially striated.
Orbicular, slightly oblique. *P. Cainozoicus.*

II. Radially ribbed.
Ribs, about 39; wider than long. *P. laticostatus.*
Ribs, about 29; longer than wide. *P. McCoyii.*
Ribs, about 29; subtrigonal. *P. subtrigonalis.*
Ribs, about 24, elevated; orbicular, tumid. *P. convexus.*
Ribs, 40 or more; orbicular, depressed. *P. lenticularis.*

Pectunculus Cainozoicus, *T. Woods, sp.* Plate x., figs. 8*a*—8*b*.

Reference.—*Cucullæa Cainozoica*, T. Woods, Proc. Roy. Soc., Tasmania, for 1876; p. 111.

"Shell roundly trigonal, oblique, globose, smooth, faintly and closely marked with radiating ribs and concentric striæ, the latter well defined and somewhat rugose at the margin and sides. Umbones very acute and recurved. Ligamental area arched, broad, with six straight grooves on each, which are well defined, and overlap each other alternately under the umbo; hinge-teeth, 6-7, bent under the hinge, and then bicuspidate. Margin of valves finely pectinated with very distinct crenulations, which continue in young shells all round as far as the hinge. Young shells are also more quadrate, and have the angular ears slightly developed" *(T. Woods)*.

Var., pl. x., figs. 8*a*—8*b*.—This differs from the type in being more orbicular, less narrowed at the hinge-line—characters very conspicuous in young shells. The variety is hardly separable from *P. pulvinatus*, Lamk., of the Parisian Eocene, which is, however, more gibbous at the umbones, and is equilateral.

Digitized by Google

Dimensions.—Length, 45; width, 42; thickness through valves, 33 millimetres.

Localities.—*Type*, Table Cape (*R. M. Johnston!*). *Var.*, common at Muddy Creek; Adelaide bore.

Pectunculus laticostatus, Quoy and Gaimard (?).

References.—Voy. de l'Astrolabe, t. 77, figs. 1-6, vol. iii., p. 466, McCoy, Prod. Pal., Victoria, Dec. ii., t. xix., figs. 10-14.

Localities.—Bird Rock, Geelong; of small size, Schnapper Point (*McCoy*).

This identification of the fossil and the living species has been disputed by Mr. R. M. Johnston. The material at my command is not sufficient to permit me to express an opinion, though I have little hesitation in accepting Prof. McCoy's determination in respect to the fossils represented by fig. 10.

Pectunculus McCoyii, R. M. Johnston.

Reference.—Proc. Roy. Soc., Tasm., for 1884, p. 199.

The characteristic shell of Table Cape, previously referred to the living species, *P. laticostatus*, is regarded by Mr. Johnston as specifically distinct, with the following differential characters:—Ribs, 29 (not 39), less solid, longer than broad, more convex towards the margin; hinge teeth, 10.

A thin, sub-orbicular, narrowed at the hinge, depressed shell, never exceeding 30 millimetres diameter, very abundant at Muddy Creek, is tentatively included under *P. McCoyii*.

Localities.—Table Cape, Tasmania; Cape Schank, Victoria (*R. M. Johnston!*); Muddy Creek and Schnapper Point (*R.T.*).

Pectunculus subtrigonalis, *spec. nov.* Pl. xi., figs. 6*a*—6*b*.

Shell solid, somewhat sub-trigonal, sub-equilateral, oblique, slightly produced posteriorly, moderately convex, radiately ribbed; ribs about 29, rounded, separated by flat narrower interspaces, the whole surface crossed by regular, sub-distant, subimbricating lamellæ, and a few folds of growth; umbones small, approximate; hinge line very short, ligamental area small; cardinal teeth eight in front and seven behind the edentulous centre; internal margin of valves strongly crenate.

This species is conspicuous by its narrow hinge line, the valves attaining the greatest transverse diameter at about four-sevenths the distance from the umbo to the front.

Dimensions.—Length, 32; width, 31; thickness through both valves, 19 millimetres.

Localities.—Common in the calciferous sandrock of the River Murray cliffs near Morgan (*R.T.*); rare Muddy Creek (*J. Dennant!*).

Digitized by Google

Pectunculus convexus, *spec. nov.* **Plate xi., figs. 7*a*—7*b*.**

Shell solid, orbicular, but slightly transverse, tumid; subequilateral; umbones approximate, radiately ribbed. Ribs about 24, rounded, elevated, interspaces concave wider than the ribs, crossed all over with thick concentric wavy laminæ becoming finer towards the front. Inner margin of valves strongly crenate. Cardinal teeth about ten on each side.

Dimensions.—Length, 31; width, 33; thickness through both valves, 22 millimetres.

Localities.—Muddy Creek. Imperfect specimens oyster banks North-west Bend on the R. Murray; Hallett's Cove and Aldinga Bay.

This species has some resemblance to the recent *P. flabellatus*, T. Woods, but is more inflated and with wider interspaces between the ribs.

Pectunculus lenticularis, *spec. nov.* **Plate xi., fig. 1.**

Shell rather thin, orbicular, but slightly transverse, depressed, equilateral; radiately ribbed. Ribs numerous (more than 40), very fine, rounded, narrower than, or about as wide as, the interspaces, crossed all over with fine concentric wavy lines. Inner margin of valves narrowly toothed; umbones very small, approximate; ligamental area very small, cardinal teeth 11 on each side.

Dimensions.—Length, 31; width, 29; greatest thickness through both valves, at about one-third the distance from the front, 12 millimetres.

Locality.—Glauconitic sands, Adelaide bore.

SUB-FAMILY ARCINÆ.

Synopsis of Species.

Arca.

Valves gaping ventrally; umbones high, wide apart.

Hinge teeth numerous, transverse. *A. pseudonavicularis.*

Hinge teeth few, all oblique. *A. equidens.*

Barbatia.

Valves closed or sinuated ventrally; umbones approximate; teeth numerous, transverse, gradually becoming larger and more oblique towards the extremities.

Transversely oblong; left valve radially ribbed; right valve smooth, with contused impressions. *B. dissimilis.*

Oblong with concentric ridges thickly granulose or plicate; gibbous. *B. crustata.*

Elongate-oblong, with concentric fimbriated ridges. *B. celleporacea.*

Digitized by Google

Surface with granular ribs.

Elongate, suboval; umbones subanterior. *B. limatella.*

Id., posterior side attenuated. *B. consutilis.*

Trapezoidal, posteriorly keeled; umbones anterior. *B. simulans.*

Ovate-oblong; strongly ribbed on the posterior slope. *B. pumila.*

MACRODON.

Valves closed; umbones approximate; posterior teeth laminar horizontal; anterior teeth few, short, oblique.

Sculpture of flat concentric ridges transversed by distant riblets. *M. Cainozoicus.*

Arca pseudonavicularis, *spec. nov.* Pl. xi., fig. 8.

Shell elongate, subtrapeziform, tumid; front margin obliquely rounded; posterior margin somewhat attenuated, obliquely truncated, with the posterior slope strongly angulated; hinge line straight. Umbones anterior, distant, acute; ventral margin sinuately excavated; inner margin of valves plain. Surface ornamented with concentric fimbriated folds; posterior slope unequally, radiately ribbed. In young specimens the surface is unequally cancellated, and the radial ribbing on the anterior and posterior areas is very pronounced. Hinge area broad, with a well defined triangular area under the beak; teeth very numerous, small, transverse.

Dimensions.—Greatest length, 27; width, 12·5; thickness through both valves, 14 millimetres.

Localities.—Adelaide bore (*R.T.*); Table Cape (*R. M. Johnston!*).

The living analogue of this species is *A. navicularis*, Brug., as known to me from Port Darwin, from which it differs in the umbones being not near the front, in the somewhat emarginate anterior side, and in the finer ribbing on the posterior slope.

Arca equidens, *spec. nov.* Pl. xi., fig. 9.

Shell elongate-oblong, tumid, with a depression extending from the umbo to the ventral margin, which is somewhat insinuated; anterior side acutely angular, posterior side elongated, obtusely angular or truncated, with a roundly angular posterior slope; hinge line straight. Umbones at the anterior third, narrow, acute, wide apart. Surface with concentric, imbricating ridges and radial threads or ribs. The ornament varies in respect to the relative strength of the radial ribs and concentric ridges; in some it is of the nature of fimbriated concentric ridges, whilst in the other extreme it consists of radial ribs variously thickened at the intersections with the

Digitized by Google

concentric lines. Inner margin of valves not crenulated. Hinge area broad, longitudinally fine-lined; central tooth v-shaped succeeded on each side by about seven equal lamelliform oblique teeth, delicately crenulated on the sides.

This species cannot be mistaken for *Arca pseudonavicularis* whilst the character presented by the hinge teeth separates it from all congeners.

Dimensions.—Length, 8·5; width, 4; thickness through both valves, 6 millimetres.

Localities.—Abundant in the lower beds Blanche Point Aldinga; and Adelaide bore.

Barbatia dissimilis, *spec. nov.* Pl. xi., figs. 4 and 5.

Shell transversely-oblong, somewhat tumid, obliquely rounded in front, subobliquely truncated behind, with a roundly angulated posterior slope. Umbones at about the anterior-third, acute, moderately wide apart; ventral and dorsal margins nearly parallel, front margin not sinuated. Left valve ornamented with radial ribs crossed by concentric threads, producing imbricating granulations at the intersections. Right valve with equidistant concentric folds, with pitted sculpture between them. The peculiar sculpture may be the scars of deciduous imbricating scales, traces of which are preserved on the posterior and anterior slopes, particularly on the former, where they are grouped in radial lines. Hinge area narrow, with a few marginal longitudinal ridges, and a transverse lanceolate groove beneath the beak and indenting the hinge line. Teeth few, large, transverse, but becoming slightly oblique towards the ends; about eight in front, and about fourteen behind the umbo.

Localities.—Very common in the Turritella limestone bands, Blanche Point, Aldinga Bay; and in the argillaceous glauconitic sands, Adelaide bore.

Dimensions.—Length, 7; width, 5; thickness through both valves, 4 millimetres.

Barbatia crustata, *spec. nov.* Pl. ii., fig. 16.

Shell small, oblong, tumid, medially impressed, and sinuated ventrally. Umbones broad, incurved, approximate, anterior. Anterior side short, roundly truncate; posterior side elongated, obtusely truncated; posterior slope very narrow, precipitous. Surface with thick concentric lamellæ, radially plicate or granular. Inner margin of valves plain; hinge teeth numerous, small, transverse.

Dimensions.—Length, 7; width, 3·5; greatest thickness through both valves on the posterior ridge, 6 millimetres.

Digitized by Google

Locality.—Oyster beds of the River Murray cliffs at the North-West Bend.

Has a resemblance to *Arca equidens*, mihi, but with a coarser ornament, shorter posterior side, &c.

Barbatia celleporacea, *spec. nov.* Pl. x., fig. 10.

Shell elongate-oblong, rather compressed, inequilateral; anterior side short, narrow, acutely angular; posterior side elongated, obtusely angular, with the posterior slope carinated; ventral side slightly sinuated. Hinge line straight. Umbones anterior, approximate, depressed, acute. Surface ornamented with concentric folds raised into frills; the latter in aged specimens pass into uncinate scales or hollow tubercles, the fimbriations within the interstitial spaces not infrequently perforated, the entire ornamentation simulating a polyzoal growth, as in *Cellepora*. The concentric folds show coarse distant growth lines. Internal margin strongly crenulated; ligamental area very narrow; teeth small, numerous in a transverse series, increasing in size and becoming slightly oblique towards the extremities.

Dimensions of a large specimen:—Greatest length, 26; width, 10; thickness through both valves, 7·5 millimetres.

Localities.—Victoria: Common at Muddy Creek; Schnapper Point (*R.T.*). Tasmania: Table Cape (*R. M. Johnston!*).

This species has much resemblance to *Barbatia* (*Acar*) *laminata*, Angas, inhabiting South Australian waters, and therefore to *Arca squamosa*, Lamk., but it is more elongate, not so tumid, with narrow acute umbones, and the front margin more angular.

Barbatia limatella, *spec. nov.* Plate x., fig. 2.

Shell elongate suboval, moderately inflated, inequilateral; umbones subanterior, incurved very close together; anterior side short, rounded; posterior margin obliquely roundly truncated; hinge-line straight; ventral margin straight or slightly arcuate, slightly insinuated medially. Surface radiately fine-ridged, dichotomously dividing, more or less granulose or scaly where crossed by the numerous equidistant imbricating folds; the depressed posterior slope conspicuously radiately ridged. Hinge area very narrow, almost wanting in young specimens, divaricately furrowed; central teeth numerous, small, transverse, with a few short, oblique, fold-like teeth towards the extremities.

Dimensions of a large specimen.—Length, 50; width, 28; thickness through both valves, 19 millimetres.

Localities.—Sandy clays at Blanche Point, Aldinga Bay, and argillaceous glauconitic sands, Adelaide bore.

Digitized by Google

The living analogues of this fossil species are *B. lima*, Reeve and *B. decussata*, Sby. From the first it differs in its coarse ornament, particularly on the less angular posterior slope, an in its longer posterior side. From the second, with which i agrees well in ornament and in general shape, it differs by it longer and straighter hinge-line, longer posterior side, and b the stronger and more laminar and oblique teeth on the mai ginal areas.

Barbatia consutilis, *spec. nov.* Plate ii., fig 15.

Shell elongate-oval, moderately convex, medially impressed umbones subanterior, incurved, close together; anterior sid short, rounded; posterior side elongated, attenuated, obliquel truncated. Surface radiately fine ridged, more or less granulos where crossed by the equidistant concentric threads; the wor surface regularly tessellated.

Dimensions of a large specimen.—Length, 41; width, 20 thickness through both valves, 16 millimetres.

Locality.—Common at Muddy Creek.

Similar to *B. limatella*, but especially distinguished by it attenuate posterior side.

Barbatia simulans, *spec, nov.* Plate xi., fig. 10.

Shell transversely trapezoidal, moderately inflated, ver inequilateral, umbones anterior, incurved, close together anterior margin very short, obtusely roundly truncate, posteric side elongated, obtusely truncated with a well-defined posteric slope; hinge-line straight; ventral margin inconspicuousl insinuated. Surface with flattish granular ridges wider tha the interspaces. Hinge area very narrow, with about seve divaricating cartilage furrows; teeth numerous, transverse becoming more oblique towards the extremities.

Dimensions.—Length, 34; width, 19; thickness through bot valves, 14 millimetres.

Localities.—Muddy Creek, Hamilton; oyster banks, North West Bend, on the R. Murray.

This species is closely related to *B. lima* and *B. limatell* from which it is distinguished by the shorter anterior side obtusely truncated, and by its granular ornamentation mos conspicuously so on the posterior slope. *B. limatella* want the posterior angulation of this species.

Barbatia pumila, *spec. nov.* Pl. x., fig. 7.

Shell small, ovate-oblong, moderately convex, inequilateral umbones anterior, rather broad, obtuse, approximate; anterio side short, rounded; posterior side depressed, subangular, it margin obtusely roundly truncate; dorsal and ventral margin

Digitized by Google

straight; valves closed, inner margin crenulated, conspicuously so on the posterior side. Surface ornamented by flatly rounded radial ribs, broader than the interspaces, and concentric striæ and folds, producing granular thickenings at the intersections; the radial ribs are very prominent on the posterior slope. Hinge area very narrow, teeth numerous, transverse, becoming larger and slightly oblique towards the extremities.

Dimensions.—Length, 9; width, 5; thickness through both valves, four millimetres.

Locality. — Not uncommon in the upper beds at Muddy Creek, Hamilton.

Macrodon Cainozoicus, *spec. nov.* Pl. x., fig. 4.

Shell elongate, subrhomboidal, somewhat compressed, inequilateral; anterior side short, acutely angular, somewhat acuminate; posterior side elongated, truncated with a well defined posterior slope; hinge line straight; ventral margin insinuated in the middle, the antero-ventral line rapidly ascending. Umbones subanterior, not widely separated, slightly incurved. Surface with concentric flat ridges, broader than the deep sulci, and radial threads interrupted by the furrows. Internal margins of valves smooth; ligamental area narrow, with a few longitudinal ridges; teeth radiating from an edentulous centre, five or six anterior, short, oblique; posterior several, laminar, parallel with the hinge line.

Dimensions of a large specimen:—Length, 27; width, 10; thickness through both valves, 9 millimetres.

Localities.—South Australia: calciferous sandstones, River Murray Cliffs, near Morgan; Adelaide bore; Aldinga. Victoria; Schnapper Point, Muddy Creek and Corio Bay (*R.T.*).

Prof. Hutton, in Trans. N.Z. Institute, vol. xvii., p. 331, 1885, describes an ark under the name of *Macrodon australis*, which I think, after examination of an authentic specimen, would be better placed in the genus *Cucullæa*. My species does not conform with the typical species of the genus, but it is generically identical with certain Jurassic and Cretaceous forms which have been associated therewith.

Genus Cucullæa.

synopsis of species.

Very gibbous, with granulated ridges. *C. Corioensis.*
Not so gibbous; umbones narrower, ribs more numerous, narrower, and finer. *C. Adelaidensis.*

Digitized by Google

Cucullæa Corioensis, McCoy.

Reference.—Prodr. Pal., Victoria, Dec. III, t. 27, figs. 3-5, 1876.

Localities.—Victoria: common at most of the localities; Corio Bay; Bird Rock Point; Point Addis; Gellibrand River; Muddy Creek!; Mordialloc; Dog Island, Leigh River; Bairnsdale; Jemmy's Point, Gippsland Lakes; Schnapper Point (*McCoy*).

Tasmania: Table Cape! (*R. M. Johnston*).

South Australia: very common in the calciferous sandrock of the R. Murray Cliffs, near Morgan; in a well-sinking at the Nine-mile Camp, near Morgan; casts in the hard calciferous sandstones associated with the oyster banks at Aldinga and Adelaide (*R.T.*)

Cucullæa Adelaidensis, *spec. nov.* Pl. xi., fig. 14.

Shell obliquely trapezoidal, very tumid, inequilateral; umbones large, incurved, slightly in front; anterior margin rounded, ventral margin straight, oblique to the straight hinge line; posterior margin slightly undulating, obtusely truncated; posterior slope flattened, separated from the moderately convex rest of the valve by an obtusely rounded ridge extending from the umbo to the post-ventral margin. Surface ornamented with fine, narrow, radial riblets, not much wider than the impressed furrows, crossed by numerous close-set retroflexed laminæ of growth. In the umbonal region the transverse laminæ are wider apart, and at the intersections form granulations, but towards the front they are more crowded, and are raised on the riblets into squamæ. The radial riblets increase by bifurcation, and at the proximal end the duplication is indicated by a linear sulcus. Inner margin of the valves coarsely ridged. The ligamental area is marked with five impressed divaricating furrows. There are three or four anterior and four or five posterior longitudinal laminar teeth. The central teeth are small and transverse, and increase in size and obliquity outwards. The post-adductor muscular impression with a thickened, but not elevated, inner margin.

Dimensions of an average-sized specimen:—Length from antero-dorsal to post-ventral margin, 44; width from umbo to ventral margin, 29; thickness through both valves, 30.

Locality.—Many specimens obtained from the glauconitic sands, Adelaide bore.

This species closely resembles *C. Corioensis*, but may at a glance be distinguished by its more oblique outline and finer sculpture; also it is less tumid, the umbones not so wide, and the radial ribs are narrower and more numerous.

Digitized by Google

FAMILY TRIGONIIDÆ.

GENUS TRIGONIA.

SYNOPSIS OF SPECIES.

Transversely ridged on the anterior two-thirds of the valves; posterior slope radially ridged.
- Ridges plain. *T. semiundulata.*
- Ridges with tubular projections. *T. tubulifera.*

Whole surface of valves radially ridged.
- Ribs acute with spinous tubercles. *T. acuticostata.*
- Ribs thick, anterior ones with blunt tuberculations. *T. Howitti.*

Trigonia semiundulata, McCoy.

References.—Geological Magazine, vol. 3, p. 481, and Pal. Victoria, Dec. II., pl. xix., figs. 4, 5.

Localities.—Victoria: very abundant in the sandy beds of Bird Rock Bluff, near Geelong (*McCoy*); Muddy Creek (*R.T.*); Tasmania: Table Cape! (*R. M. Johnston*); South Australia: silicified sandstone blocks in the sharp sands underlying the pebble bed at Gawler (*R. T.*). Also quoted by Hutton from the Pareora Series at Awamoa, New Zealand.

Trigonia tubulifera, Tate, Plate xi., figs. 13*a*—13*b*.

Reference.—Southern Science Record, January, 1885, p. 3.

Shell minute, quadrate; the flattish posterior area with about 16 thin radial ribs beset with truncate tubular projections; the remainder of the surface with about 20 concentric ribs similarly ornamented.

The tubular projections are short though conspicuous, and are separated one from the other by intervals not much wider than the tubes. Only two examples have occurred to me—one, a left valve, from Schnapper Point, on which the two areas are well-marked, the other, a right valve, from Muddy Creek, has the anterior area so masked by the long tubular projections as to conceal the concentric arrangement of the ribs.

Length and height, about 5 millimetres.

Trigonia acuticostata, McCoy.

References.—Geological Magazine, vol. 3, p. 482, and Pal. Victoria, Dec. II., pl. xix., figs. 1, 2.

Localities.—Muddy Creek and Mordialloc, Victoria (*McCoy*); oyster beds of the Upper Murravian at the North-west Bend Head Station, R. Murray, in South Australia (*R. T.*) Casts, probably of this species in beds of the same age at Tickera near Wallaroo, and at Aldinga.

It has been reported by Prof. McCoy (Ann. and Mag. Nat. Hist., 1876, p. 273) living in Bass Straits.

Digitized by Google

Trigonia Howitti, McCoy.

Reference.—Palæontology of Victoria, Dec. III., pl. xxvii figs. 1—2*c*, 1876.

Locality.—Sandy marl at Jemmy's Point, near the entranc of the Gippsland Lakes, collected by Mr. A. Howitt, afte whom it is named.

FAMILY CRASSATELLIDÆ.

Genus Crassatella.

SYNOPSIS OF SPECIES.

A. Valves with plain margins.
- Elongate ovate-trigonal. *C. oblong*
- Subquadrate; fine concentric folds. *C. astartiform*
- Subquadrate; tumulous concentric ridges. *C. corrugat*
- Subtriangular, anterior side very short, fine concentr folds. *C. abbreviat*

B. Valves with crenated margins in the adult.
- Ovate-oblong; concentrically folded. *C. Dennan*
- Ovate-trigonal; nearly smooth. *C. aphrodin*

Crassatella oblonga, *Tenison-Woods.*

Reference.—Proc. Roy. Soc., Tasm., for 1875, t. ii., fig. 1 p. 25.

Localities.—Tasmania: Table Cape! (*R. M. Johnston*). Vi toria: Muddy Creek. South Australia: Oyster beds, Nort West Bend, River Murray.

Very distinct from any existing species; is somewhat lik *C. attenuata*, Hutton, of the Older Tertiary, New Zealand.

Crassatella Dennanti, *spec. nov.* **Plate xi., fig. 2.**

Shell ovate-oblong, moderately convex, inequilateral; ur bones anterior; rounded in front, expanded, flattened, an obliquely truncated behind. Surface closely and irregular concentrically folded, folds narrow, about as wide as the fu rows, acutely rounded, minutely and regularly radially striate the broad posterior flattened area is faintly marked by a medi ridge, the lamellæ of growth in the form of thin imbricati plates. Lunule impressed lanceolate. Hinge area narrow left valve with two cardinal teeth in front of the cartilage pi and one lamellar tooth posteriorly; right valve with thr cardinal teeth in front of the pit, the middle one very thi and crenulated on the side, the outer one small and margins Inner margin of valves denticulated.

Dimensions.—Length, 57; width, 37; thickness through bo valves, 32 millimetres.

Locality.—Not rare Muddy Creek, Hamilton (*J. Dennant*).

Digitized by Google

This species, which is named after J. Dennant, Esq., Hamilton, in recognition of palæontological services rendered, has no immediate ally in recent creation, but it has some general resemblance to *C. Traillii*, Hutton, of the Older Tertiary of New Zealand, from which it differs by its truncated posterior margin and its concentric folds.

Crassatella aphrodina, Tenison-Woods.

Reference.—Proc. Roy. Soc., Tasm., for 1875, t. iii., fig. 12, p. 24.

"Ovate-trigonal, oblique solid, faintly striate and sulcate; umbones sharp, with more distinct sulci; lunule impressed; posterior side subangulate and produced. Long., 53; lat., 44 mills."

Localities.—Table Cape; Adelaide bore (fragments of hinge).

This species is related to *C. australis*, Hutton, of the New Zealand Tertiary.

Crassatella astartiformis, *spec. nov.* Pl. xi., figs. 12 and 15.

Shell subquadrate, slightly convex; umbones a little anterior; dorsal margin rather straight; posterior side roundly truncated, anterior side convex. Surface ornamented with concentric folds and minute, radial striæ; the folds are compressed, somewhat reflected, narrower than the furrows, more regular and stouter in the umbonal region.

Dimensions of a very large specimen:—Length, 20; width, 17; thickness through both valves, 8 millimetres.

Localities.—Very abundant of small size, Aldinga and Adelaide bore; rare, R. Murray Cliffs; Muddy Creek and Schnapper Point (*R.T.*).

Crassatella corrugata, *spec. nov.* Pl. ii., fig. 14.

Shell subquadrate, similar to *C. astartiformis*, but proportionately longer; surface with a few high angular corrugations, and striated between.

Dimensions.—Length, 6; width, 4·5 millimetres.

Locality.—Clays with *Turritella Aldingæ* at Blanche Point, Aldinga Bay.

Crassatella abbreviata, *spec. nov.* Pl. xi., fig. 16.

Shell subtriangular, elevated, compressed, inequilateral; umbones anterior, prominent; dorsal margin much sloped; anterior side very short; posterior margin roundly truncated. Surface ornamented with numerous narrow concentric folds. Inner margin of valves plain.

Digitized by Google

Dimensions.—Length, 8·5; width, 7·5; thickness throug
both valves, 3 millimetres.

Locality.—Calciferous sandstones, R. Murray Cliffs, ne
Morgan.

FAMILY ASTARTIDÆ.

Genus Micromeris, *Conrad.*

SYNOPSIS OF SPECIES.

Ornament of fimbriated, imbricating lamellæ.	*M. rugos*
Ornament of radial ridges and simple folds.	*M. radiat*

Micromeris rugosa, *spec. nov.* **Plate x., fig. 11.**

Shell trigonal, compressed, with produced somewhat a
tenuated rather straight umbones, equilateral; anterior ar
posterior slopes straight, inclined at an acute angle; ventr
margin rounded; inner margin of valves distantly crenulate
Lunule narrow, not deeply impressed. Surface crowded wit
thin imbricating lamellæ; the edges of the lamellæ varyin
from simple to thickly fimbriated, the fimbriations correspon
ing with rounded depressed radial riblets.

Dimensions.—Length, 3; width, 3·5 millimetres.

Locality.—Lower beds, Adelaide bore.

Micromeris radiata, *spec. nov.* **Plate x., fig. 12.**

Shell trigonal, slightly convex, with produced rather straigh
umbones, equilateral, ventrally rounded; inner margin
valves distantly crenulated. Surface smooth, shining, radiall
ribbed, and concentrically ridged or coarsely striated. Un
bones in contact, bounded before and behind by a deep elli
tical depression, angulated on the margin.

Dimensions.—Length, 4·5; width, 4·5; thickness throug
both valves, 2·5 millimetres.

Localities.—Very common in the lower beds, Blanche Poin
Aldinga Bay, and Adelaide bore.

Gouldia lamellata, *spec. nov.* **Plate ii., fig. 17.**

Shell subtriangular to subquadrangular, compressed
moderately convex; umbones anterior, rather elevated an
acute. Surface with about twenty thin, elevated, concentr
lamellæ, and striæ of growth. Inner margin of valves wit
large, close crenulations. The shell differs in shape, in th
amount of compression, and in the number of the lamell
folds; but one set of characters is not correlative with anoth
set, so that the variations are individual, and not specific. Th
subquadrangular forms have a close resemblance to a *Chion*
allied to *Venus Allporti*, T. Woods, occurring in the sam
beds.

Digitized by Google

Dimensions.—Length, 5·5; width, 5 millimetres.

Localities.—Not uncommon in the lowest beds, Blanche Point, Aldinga, and Adelaide bore.

Genus Mytilicardia.

SYNOPSIS OF SPECIES.

Posterior side widened; ribs 21.	*M. alata.*
Posterior side narrowed; ribs narrow, 15.	*M. compta.*
Posterior side narrowed; ribs broad, 12.	*M. platycostata.*
Shell trapeziform, uniformly ribbed.	*M. curta.*

Mytilicardia alata, *spec. nov.* Plate ii., fig. 12.

Shell ovately-oblong, somewhat depressed; anterior side very short, truncated; widely rounded and compressed posteriorly; ventral margin nearly straight, inconspicuously sinuated.

Surface radially ribbed, with lamellar or spiny projecting scales, and undulating concentric lines of growth. Four ribs of large dimensions occupy the ridge extending from the umbo to the post-ventral angle; these are broad, rounded, not much elevated, rather abruptly narrowed to form a surmounting rib, which carries the distant spiny scales. The anterior ribs are twelve in number, densely covered with scaly spines. The posterior ridge is succeeded by a broad space with two flat ribs, posterior to which are three compressed ribs with imbricating spinous scales. Inner margin of valves coarsely crenulate.

Dimensions.—Length, 25; greatest width, 20; width at umbo, 12 millimetres.

Locality.—Adelaide bore.

This species is distinguished from *M. crassicostata*, and allied species possessing lamellar scales on the ribs, especially by its wing-like posterior slope; in the longitudinal constriction of the primary ribs it resembles *M. Novæ Hollandiæ*, Deshayes.

Mytilicardia compta, *spec. nov.* Plate xii., fig. 2.

Shell elongately ovate, somewhat depressed; ventral margin inconspicuously sinuated, in other respects similar to *M. crassicostata*, Lamk. There are four primary subangulated ribs, posterior to which are two narrow ribs succeeded by two compressed elevated ribs; the anterior ribs are seven in number. All the ribs are more or less raised into lamellar scales.

Dimensions.—Length, 29; greatest width, 17; width at umbo, 12 millimetres.

Localities.—Muddy Creek; oyster banks at North-west Bend Head Station, on the River Murray.

Digitized by Google

This species differs from *M. crassicostata* by its narrowe shape, depressed umbones, and subacute ridges, and by th absence of a subanterior contraction ventrally.

Mytilicardia platycostata, R. M. Johnston.

Reference.—Proc. Roy. Soc. Tasm. for 1879, p. 40.

"Shell oblong ovate, ornamented with twelve broad slightly raised squamose radiating ribs, surmounted by a smaller ridg of distant lamellose spines; breadth of interspaces and ray equal; rays finer and closer together as they approach the slop Long., 50 mil.; lat., 35 mil.; alt. (both valves), 26 mil. Rare Table Cape." R. M. Johnston.

Mytilicardia curta, *spec. nov.* Pl. ii., fig. 9.

Shell trapeziform, anteriorly very short, extremely gibbous ventral margin straight, with a slight insinuation anteriorly posterior margin roundly truncated; roundly elevate diagonally from the umbo, the posterior and dorsal portio somewhat dilated and convex; the ventral side is compara tively narrow and precipitous. Surface ornamented with 2 narrow, rather compressed, scaly, radial ribs; interstitia spaces slightly narrower than the ribs, marked with regula transverse liræ; margin of valves coarsely crenulated.

Dimensions.—Length, 13; greatest width towards the po terior margin, 11; width through the umbo, 8; thickne through both valves, 11 millimetres.

Locality.—Adelaide bore.

This species, which has a general resemblance to *Cardi trapezia*, Bruguiere, makes through *C. scabrosa*, mihi, an a proach to the genus *Cardita*.

Genus Cardita.

synopsis of species.

Triangular; ribs, 15, granose. *C. trigonali*
Ovate-triangular; ribs, 22, thin. *C. pecte*
Rotund; ribs, 24, granose, linear interspaces. *C. compact*
Ovate-quadrate; ribs, 20, thick, crenulated. *C. Murrayan*
Oval-subquadrate; ribs, 30, with erect scales. *C. scabros*
Rotundly heart-shaped; ribs, 22, spinosely serrated. *C. spinulos*
Roundly oblong; ribs, about 30, with lamellar scales. *C. gracilicostat*
id., widened posteriorly. *C. latissim*
id., narrowed anteriorly; ribs, 37. *C. polynem*
Roundly oblong; ribs, less than 30, with granulations.
Ribs, 26; fine granulations. *C. delicatul*
Ribs, 22; coarse granulations. *C. Tasmanic*

Digitized by Google

Cardita trigonalis, *spec. nov.* Pl. ii., fig. 1.

iangular, moderately convex; umbones elevated, lique, incurved, anterior; posterior margin inclined, th the slightly arched ventral margin a roundly e; anterior side rounded; dorsally excavated. Sur- ented with 15 crenately-nodulose, rounded, radiating terspaces wider than the ribs with transverse thick er margin of valves coarsely crenulated.

ons.—Length, 7; width, 6·5 millimetres.

—Oyster banks, Blanche Point, Aldinga Bay.

Cardita pecten, *spec. nov.* Plate ii., fig. 11.

ately triangular, transverse, rather depressed, regu- ex, except the flattened posterior slope; umbones e, antemedian, directed forwards; anterior margin posterior obliquely truncated. Inner margin of rsely crenulated. Surface ornamented with 22 mpressed, crenately-granose, radial ribs; interspaces than the ribs.

ons.—Length, 6·5; width, 2; length from umbo to ngle, 6·5; thickness through both valves, 3 milli-

s.—Muddy Creek; Oyster-beds, North-West Bend er Murray.

Cardita compacta, *spec. nov.* Plate ii., fig. 13.

inute, rotund, subglobose, subequilateral; umbones , obtuse, incurved, approximate. Surface ornamented enately-granose ribs separated by linear interspaces. gin of valves crenately-serrated.

ons.—Length, 5; width, 4·5; thickness through both millimetres,

.—Muddy Creek.

tle shell resembles in ornamentation *C. scalaris*, nt north-west coast of America, and fossil in the rags; and *C. amabilis*, Deshayes, living off the coast ia, from both of which it differs in shape. It has ty to *C. parva*, Lea of the Claiborne-Eocene.

Cardita Murrayana, *spec. nov.* Plate ii., fig. 2.

vate-quadrate, moderately inflated, inequilateral; erior, broad, oblique, incurved; posterior side pro- d flattened; radiately ribbed. Ribs 20, broad, elevated, crenulated; interspaces concave, about as e ribs.

ons.—Length, 35; width, 29; thickness through both

Digitized by Google

valves, 26; length of anterior side, 8; from umbo to pos ventral angle, 35 millimetres.

Locality.—Calciferous sandstone, Glenforslan, near Blanch town, on the River Murray.

This species has some affinity to *C. spinulosa*, but is mo produced and less inflated, and has a different ornament among recent species it has the shape and number of ribs *C. angisulcata*, Reeve, but in that shell the ribs are flat, broa and close together.

Cardita scabrosa, *spec. nov.* Pl. ii., fig. 4.

Shell oval-subquadrate, anterior side very short, moderate convex; umbones anterior, incurved; posterior margi abruptly truncated; posterior side slightly dilated and fla tened; inner margin of valves coarsely crenulated. Surfa ornamented with 30 narrow compressed radial ribs, about wide, or not quite so wide, as the interspaces; ribs dense covered with erect scales, which are somewhat spathulate, e cept on the posterior slope where they are somewhat oblong.

Dimensions.—Length, 21; width, 16; thickness throu both valves, 12 millimetres.

Localities.—Calciferous sandrock of the River Murray Clif near Morgan; Muddy Creek; Corio Bay.

Cardita gracilicostata, Tenison-Woods. Pl. ii., figs. 6 and 8.

Reference.—Proc. Roy. Soc., Tasm., for 1876, p. 112 (1877).

Shell roundly-oblong, transverse, inequilateral, moderate inflated; umbones anterior, oblique, much incurved. Surfa ornamented with transverse raised liræ, and about 30 curve radiating ribs, narrower than the concave interspaces; t ribs are laterally compressed, obsoletely nodular in the adu except the anterior and posterior slopes, where the nodul tions become less rounded and more lamellose. In you shells the ribs are densely beset with thick imbricating scal somewhat spinous on the posterior slope, and granulose on t anterior side; minutely granular in the interspaces. Inn margin of valves coarsely crenulated; lunule short corda well defined and deep.

Dimensions of a large specimen:—Length, 35; of posteri side, 25; width, 31; thickness through both valves, 20 mil metres.

Locality.—Table Cape, Tasmania! (*R. M. Johnston*).

Of the many recent and fossil species with which I have co pared *C. gracilicostata*, *C. acuticostata*, Lamarck, of the Angl Parisian Eocene basin, is the only one to which it bears a resemblance; from that species it differs in being less orbicul and in its simple ribs.

Digitized by Google

Cardita latissima, *spec.nov.* Pl. x., fig. 5.

quadrately orbicular, very inequilateral, inflated; um-
ear the front, oblique, incurved; anterior side short,
; acutely-roundly truncated and compressed pos-
; ventral margin regularly arched. Surface with about
laterally compressed scaly ribs, much narrower than
tish transversely striated interspaces. The ribs are
beset with erect lamellar scales, becoming somewhat
on the posterior slope and thick on the anterior area.
short, cordate, shallow; inner margin of valves coarsely
ted.

ry young shells the ribs are much fewer, granulated,
ose on the posterior slope.

nsions.—Length, 31; of posterior side, 23; width, 29;
ss through both valves, 20 millimetres.

ities.—Very abundant Adelaide bore, and Blanche Point,
Bay.

species in its ornamentation is similar to the young of
ilicostata, but the shape is very different; it is less
than the recent *C. abyssicola*, Hinds, but the sculpture
ent.

Cardita spinulosa, *spec. nov.* Pl. ii., fig. 3.

rotundately heart-shaped, inflated, inequilateral; umbo
, oblique, incurved; radiately ribbed. Ribs, 22;
y serrated, very narrow, laterally compressed; inter-
ide, densely and irregularly lamellosely wrinkled; in
onal region the interspaces and the ribs are minutely
. Inner margin of valves coarsely crenulated.

nsions.—Length, 33; width, 31; length of anterior side,
ness through both valves, 36 millimetres.

ity.—Blue clays, Schnapper Point, Hobson's Bay.

Cardita polynema, *spec. nov.* Plate ii., fig. 7.

roundly-oblong, transverse, moderately inflated; um-
nterior, oblique, incurved; anterior side very short.

ce ornamented with 37 narrow compressed radial ribs,
s wide as the interspaces; ribs densely covered with
al scales, except on the posterior and anterior slopes
hey are somewhat spinous.

nsions.—Length, 18; width, 15·5; thickness through
lves, 11 millimetres.

ity.—Schnapper Point, Port Phillip.

species agrees in shape with *C. gracilicostata*, though
duced anteriorly, but has more numerous and closer
is somewhat intermediate between that species and
ea.

Digitized by Google

Cardita delicatula, *spec. nov.* Plate ii., fig. 10.

Shell roundly-oblong, rather depressed; umbones anterio
oblique, incurved; posterior margin roundly truncated.

Surface ornamented with 26 compressed radial ribs, densel
beset with granules passing into scales on the posterior slop
interspaces a little wider than the ribs. Inner margins
valves coarsely crenulated.

Dimensions.—Length, 11; width, 10; thickness throu
both valves, 6 millimetres.

Localities.—Common in the calciferous sandrock of the Riv
Murray Cliffs, near Morgan; Muddy Creek; Schnapper Poi

With the general form of *C. gracilicostata* this species is di
tinguished by its fewer and granular ribs.

Cardita Tasmanica, *spec. nov.* Plate xii., fig. 13.

Shell thick, roundly oblong, rather depressed; umbones pr
minent, oblique, incurved; anterior side very short.

Surface ornamented with 22 thickish, elevated, densely cr
nately-nodose, radiating ribs; interspaces a little wider tha
ribs, moderately concave, transversely wrinkled. Inner ma
gin of valves coarsely crenulated.

Dimensions.—Length, 16; width, 14; thickness through bot
valves, 9 millimetres.

Locality.—Table Cape! (*R. M. Johnston*).

This species comes very near *C. delicatula*, but it has fewe
ribs, which are thicker and coarsely ornamented; it has muc
resemblance to *C. rotunda*, Lea. of the Claiborne-Eocene, bu
that species has thin, elevated, scaly ribs.

Explanation of Plates.

N.B.—The figures are of the natural sizes, except whe
otherwise stated.

Plate II.

1. Cardita trigonalis, *Tate.* Enlarged.
2. Cardita Murrayana, *Tate.*
3. Cardita spinulosa, *Tate.*
4. Cardita scabrosa, *Tate.* R. Murray Cliffs.
5. Cardita latissima, *Tate.*
6. Cardita gracilicostata, *T. Woods.*
7. Cardita polynema, *Tate.*
8. Cardita gracilicostata, *T. Woods.* A young example.
9. Mytilicardia curta, *Tate.*
10. Cardita delicatula, *Tate.* R. Murray Cliffs.
11. Cardita pecten, *Tate.* Enlarged. Muddy Creek.
12. Mytilicardia alata, *Tate.*
13. Cardita compacta, *Tate.*

Digitized by Google

14. Crassatella corrugata, *Tate*. Enlarged.
15. Barbatia consutilis, *Tate*.
16. Barbatia crustata, *Tate*. Enlarged.
17. Gouldia lamellata, *Tate*. Much enlarged.

Plate III.

1. Lima linguliformis, *Tate*. Muddy Creek. *a*, Natural size; *b*, magnified portion near the front.
2. Pecten subbifrons, *Tate*. Adelaide.
3. Vulsella lævigata, *Tate*. *a*, Exterior view, natural size; *b*, hinge-line, enlarged.
4. Modiolaria Corioensis, *Tate*. Much enlarged.
5. Modiolaria subgranosa, *Tate*. Much enlarged.
6. Pecten consobrinus, *Tate*. Aldinga.
7. Modiolaria singularis, *Tate*. Much enlarged.
8. Limea alticostata, *Tate*. Much enlarged.
9. Dimya dissimilis, *Tate*. Slightly enlarged. Muddy Creek. *a*, Exterior view of attached valve; *b*, interior view of the same; *c*, exterior of free valve.

Plate IV.

1. Ostrea hippopus, *Tate*. *a*, View from above; *b*, side view.
2. Nucula Morundiana, *Tate*. *a*, End view; *b*, seen from above; both enlarged; *c*, magnified view of surface.
3. Nucula Atkinsoni, *R. M. Johnston*. River Murray Cliffs. *a*, View from above; *b*, end view; both natural sizes; *c*, magnified view of surface.
4. Nucula fenestralis, *Tate*. Much enlarged.
5. Nucula semistriata, *Tate*. *a* and *b*, Much enlarged views.
6. Pecten spondyloides, *Tate*. A small example. Aldinga Cliffs.
7. Pecten spondyloides. Variety from Mannum.
8. Lima (Limatula) Jeffreysiana, *Tate*. River Murray Cliffs.

Plate V.

1. Placunanomia sella, *Tate*. River Murray Cliffs. *a*, Attached valve; *b*, exterior view of foramen with the shell broken away, showing the margin of the plug-sheath; *c*, interior view, showing plug-sheath.
2. Leda planiuscula, *Tate*. Natural size in outline, and much enlarged view.
3. Leda obolella, *Tate*. Natural size in outline; *a* and *b*, exterior and umbonal aspect, enlarged. Muddy Creek.
4. Pecten palmipes, *Tate*. Left valve. Edithburg.
5. Leda crebricostata, *T. Woods*. Natural size in outline; *a* and *b*, exterior and umbonal aspect, much enlarged.

Digitized by Google

6. Leda acinaciformis, *Tate*. Natural size in outline; *a* and *b* exterior and umbonal aspects, enlarged.
7. Placunanomia Ione, *Gray*. *7a*, Interior view of free valve *a*, the cartilage furrow; *b*, muscular impression; *c*, adductor impression; *7b*, exterior view of free valve.
8. Lima Bassii, *T. Woods*. River Murray Cliffs. *a*, Natural size; *b*, enlarged view of ornament.

Plate VI.

1. Ostrea Sturtiana, *Tate*. Overland Corner.
2. Gryphæa tarda, *Hutton*. *a*, Side view of attached valve *b*, free valve seen from above. Great Australian Bight.
3. Rhynchonella Baileyana, *Tate*. *a*, Seen from above; *b*, front view; *c*, side view.
4. Leda Huttoni, *T. Woods*. Aldinga.
5. Ostrea hyotis, *Linn*. Blanchetown.
6. Nucula tumida, *T. Woods*. *a* and *b*, Front and side views. Muddy Creek.
7. Leda lucida, *T. Woods*. *a* and *b*, Front and umbonal aspect of an adult example. Near Morgan.

Plate VII.

1. Pecten Aldingensis, *Tate*. *a* and *b*, Right and left valves *c*, ornamentation much enlarged.
2. Pecten Sturtianus, *Tate*. *a* and *b*, Left and right valves *c*, ornamentation much enlarged. R. Murray Cliffs.
3. Pecten Zitteli, *Hutton*. *a*, Right valve; *b*, left valve; *c*, interior of left valve; enlarged views. Muddy Creek.
4. Pecten palmipes, *Tate*. *a*, Right valve; *b*, enlarged view of an interstitial space.
5. Pecten Murrayanus, *Tate*, *a* and *b*, Right and left valves. R. Murray Cliffs.

Plate VIII.

1. Lima Bassii, *T. Woods*. *var*. Adelaide bore. *a*, nat. size *b*, Hinge area enlarged; *c*, magnified ornament.
2. Pecten polymorphoides, *Zittel*. R. Murray Cliffs.
3. Pecten Eyrei, *Tate*. Aldinga.
4. Lima polyactina, *Tate*. *a* and *c*, Interior and exterior views enlarged; *b*, magnified portion of exterior.
5. Limarca angustifrons, *Tate*. *a*, Exterior enlarged; *b*, hinge area much enlarged.
6. Pecten Eyrei, *Tate*. Scaly ornament of, slightly enlarged.
7. Pecten Flindersi, *Tate*. *var*. Aldinga.
8. Dimya sigillata, *Tate*. *a*, Interior; *b*, exterior of attached valve, enlarged.

Digitized by Google

Plate IX.

er fenestratus, *Tate.*
laria arcacea, *Tate.*
dichotomalis, *Tate.* *a* and *b*, Right and left valves; agnified view of portion of surface.
piculata, *Tate.* *a* and *b*, Enlarged views. Aldinga.
a cymbula, *Tate.* Slightly enlarged.
transenna, *Tate.* *a*, Enlarged; *b*, magnified ornamen-n.
antiaustralis, *Tate.* *a*, Natural size; *b*, portion of ce near the front; *c*, in the umbonal region, mag-l.
Woodsii, *Tate.* Adult example enlarged.
grina crassicardia, *Tate.* Young example. Muddy k.
grina crassicardia, *Tate.* Cardinal area of an adult. -West Bend of the River Murray.

Plate X.

Peroni, *Tate.* *a*, Natural size; *b*, sculpture, mag-l. Aldinga.
ia limatella, *Tate.* Adelaide.
la globularis, *Tate.* *a* and *b*, Much enlarged. Ade-
don Cainozoicus, *Tate.* *a*, Natural size; *b*, enlarged -line; *c*, magnified ornament. Muddy Creek.
eptorhyncha, *Tate.* *a* and *b*, Enlarged views. Ade-
arenicola, *Tate.* Aldinga.
ia pumila, *Tate.* Slightly enlarged. Muddy Creek.
ulus Cainozoicus, *T. Woods* Variety from Muddy k; *a* and *b*, front and umbonal aspects.
(Limatula) polynema, *Tate.* Slightly enlarged.
ia celleporacea, *Tate.* *a* and *b*, Front and umbonal cts. Schnapper Point.
neris rugosa, *Tate.* Slightly enlarged. Adelaide.
neris radiata, *Tate.* *a* and *b*, Front and umbonal cts, enlarged.

Plate XI.

culus lenticularis, *Tate.* Adelaide.
tella Dennanti, *Tate.* Muddy Creek.
la Adelaidensis, *Tate.* Adelaide.
ia dissimilis, *Tate.* Left valve, slightly enlarged. aide bore.
ia dissimilis, *Tate.* Right valve, slightly enlarged. aide bore.

Digitized by Google

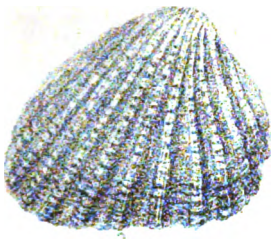
6. Petunculus subtrigonalis, *Tate.* *a* and *b*, Exterior and interior aspects. River Murray cliffs.
7. Petunculus convexus, *Tate.* *a* and *b*, Umbonal and front aspects. Muddy Creek.
8. Arca pseudonavicularis, *Tate.* *a* and *b*, Front and umbonal aspects. Adelaide bore.
9. Arca equidens, *Tate.* Much enlarged. Adelaide bore.
10. Barbatia simulans, *Tate.* Muddy Creek.
11. Avicula nasuta, *Tate.*
12. Crassatella astartiformis, *Tate.*
13. Trigonia tubulifera, *Tate.* *a*, Enlarged; *b*, magnified ornament. Muddy Creek.
14. Cucullæa Adelaidensis, *Tate.* *a*, Natural size; *b*, enlarged ornament.
15. Crassatella astartiformis, *Tate.* Young example.
16. Crassatella abbreviata, *Tate.* Slightly enlarged. River Murray cliffs.

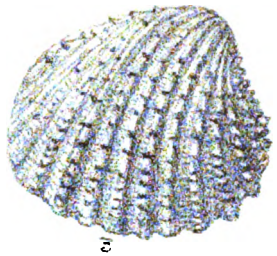
Plate XII.

1. Limopsis multiradiata, *Tate.* *a*, Enlarged view of valve *b*, surface near the front, magnified.
2. Mytilicardia compta, *Tate.* Muddy Creek.
3. Lucina dentata, *Wood.* North-West Bend.
4. Leda prælonga, *Tate.* *a* and *b*, Front and umbonal aspects much enlarged. Muddy Creek.
5. Lucina fabuloides, *Tate.* Enlarged.
6. Lucina projecta, *Tate.* Muddy Creek.
7. Lucina leucomomorpha, *Tate.* *a* and *b*, Front and umbonal aspects. Muddy Creek.
8. Saxicava australis, *Lamarck.* Adelaide bore.
9. Pinna semicostata, *Tate.*
10. Lucina nuciformis, *Tate.* *a* and *b*, Front and umbonal aspects, much enlarged.
11. Lucina planatella, *Tate.* Table Cape.
12. Avicula nasuta, *Tate.* Fragment of right valve, with the anterior wing complete.
13. Cardita Tasmanica, *Tate.*
14. Cardium cuculloides, *Tate.* *a* and *b*, front and umbonal aspects. Muddy Creek.

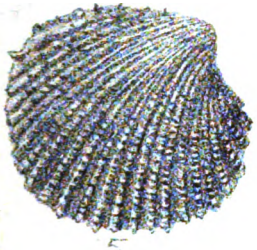
Digitized by Google

1

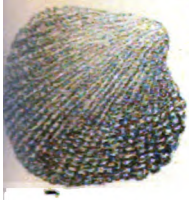

2

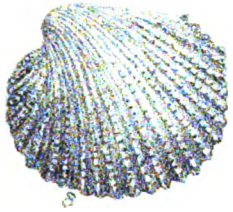

3

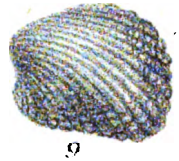
4

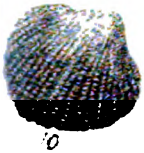

5

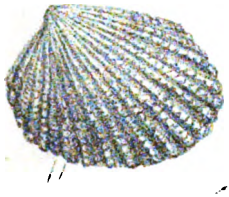
6


7


8


9


10


11

12

13

14

15

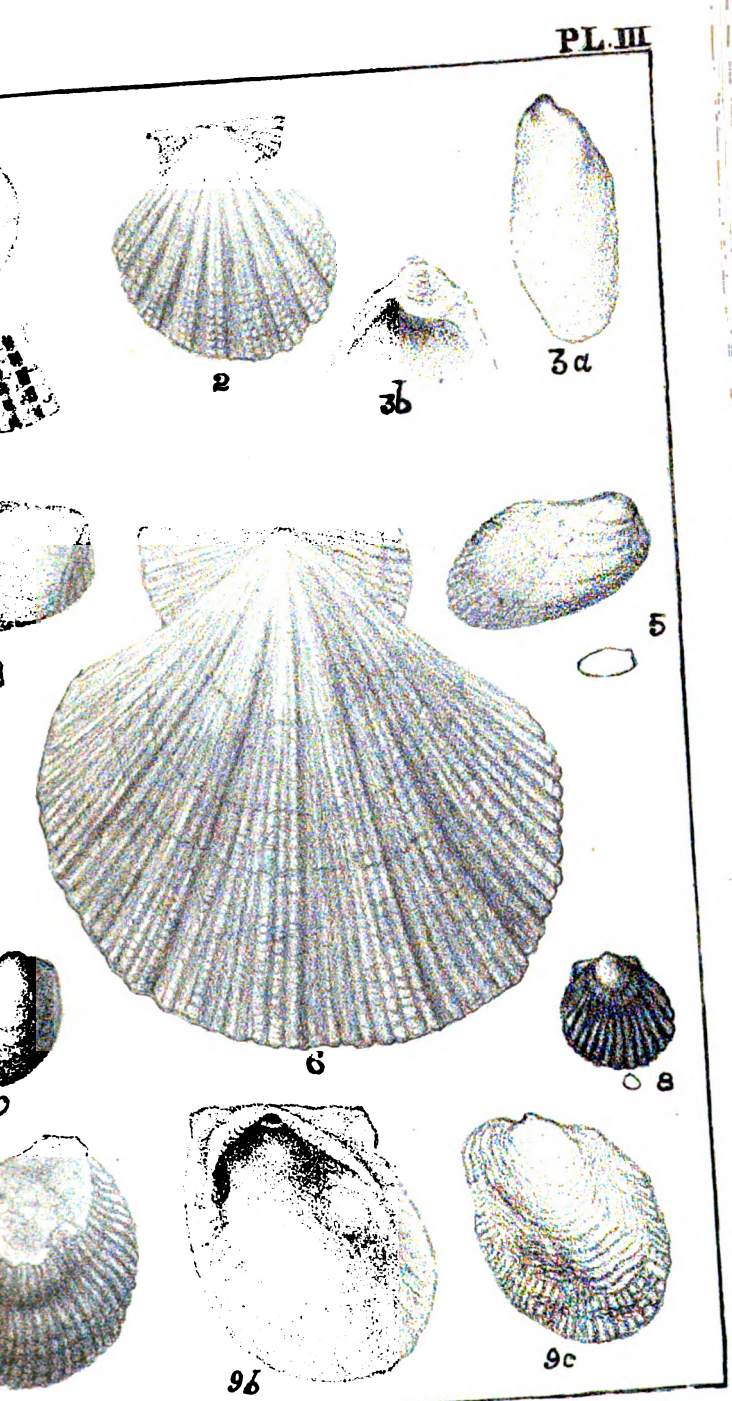
16

17b

17a

Digitized by Google

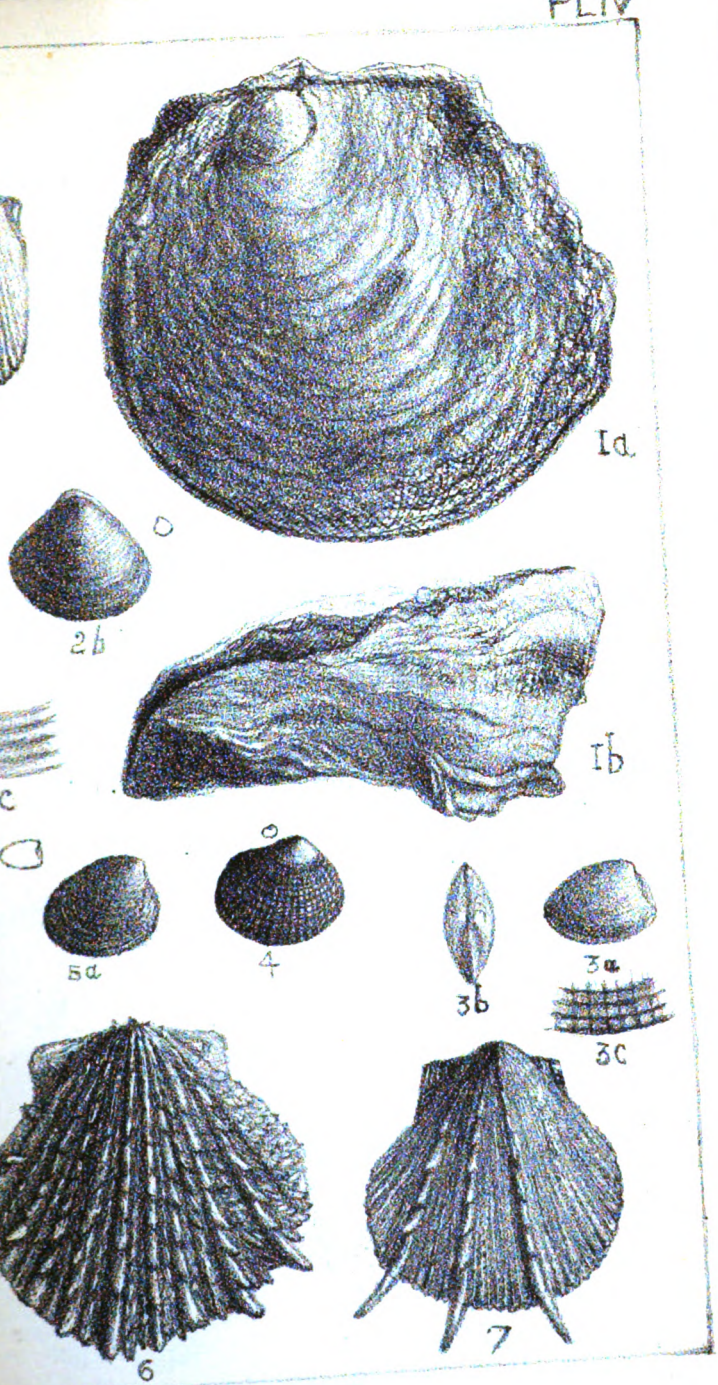
Digitized by Google



HIDLEY. DEL.

Digitized by Google

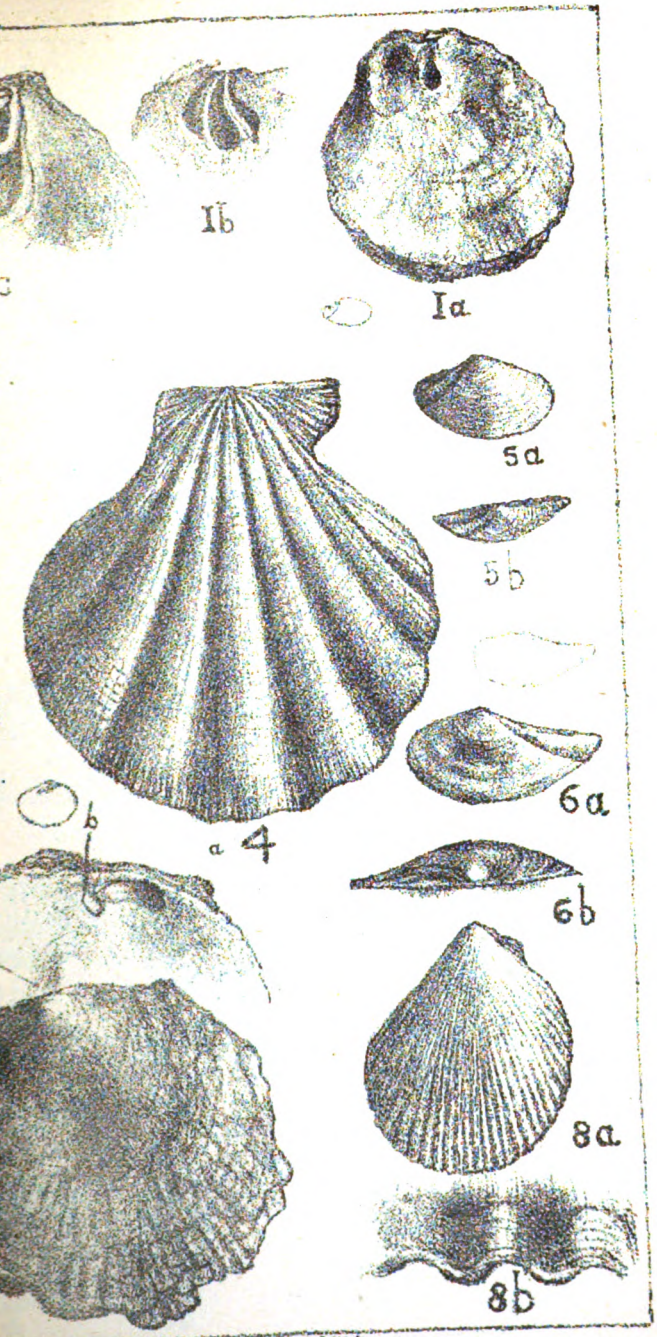
Digitized by Google



THIDLEY-DEL

Digitized by Google

Digitized by Google



W. J. CHIDLEY. DEL.

Digitized by Google

Digitized by Google

Pl. VI

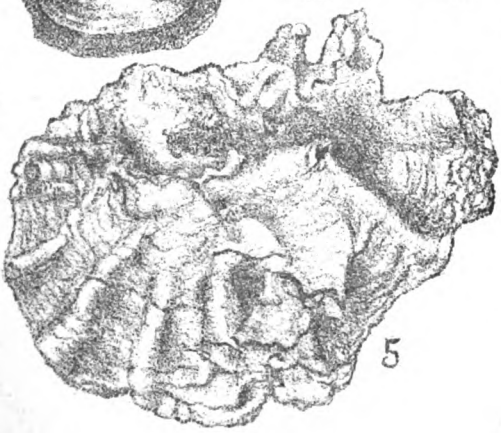
1

2a

2b

4

3a



5

3b

3c

5a

6b

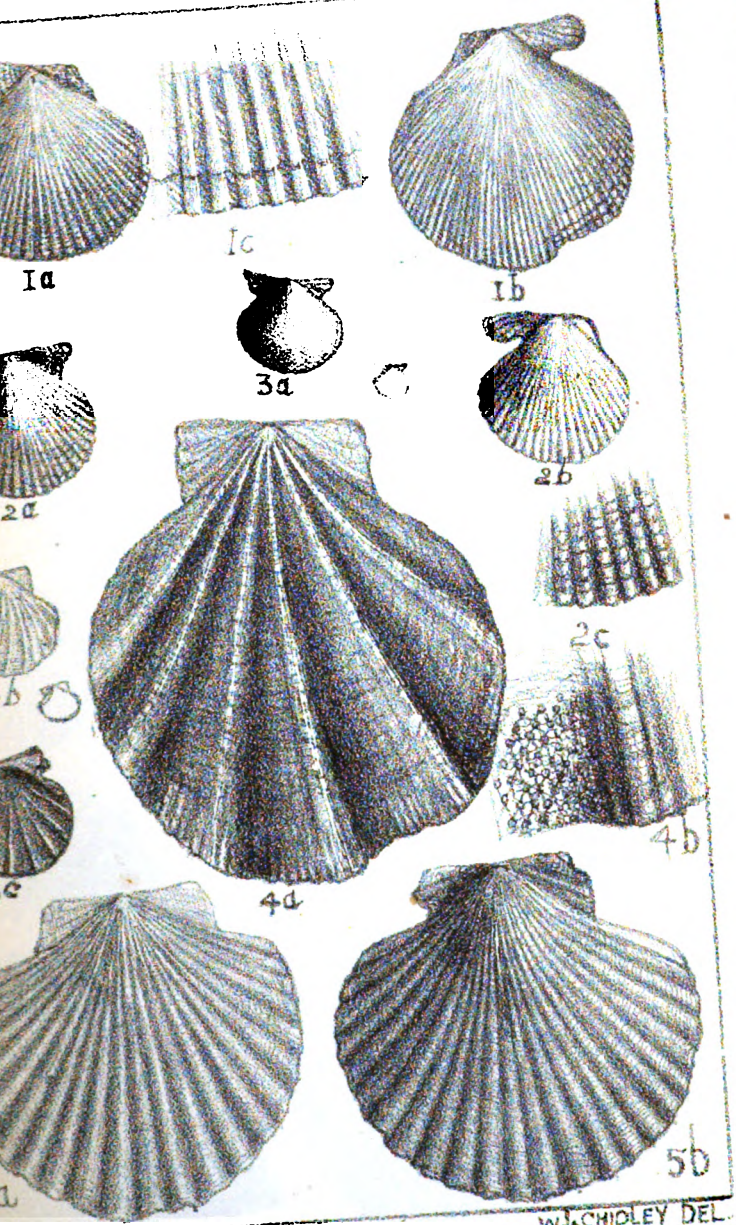
7a

7b

IOLEY·DEL

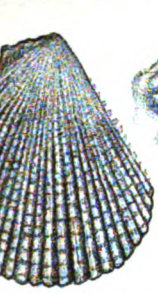
Digitized by Google

Digitized by Google



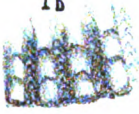
Digitized by Google

Digitized by Google

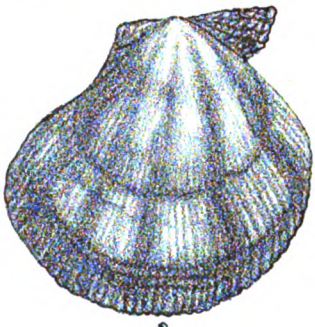


Ia

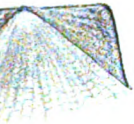
Ib



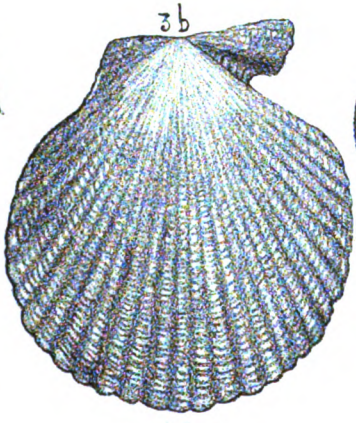
Ic



2



3a

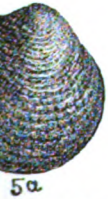


3b

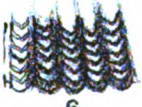
4a

4b

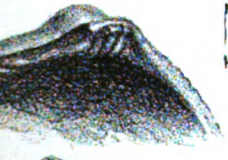
4c

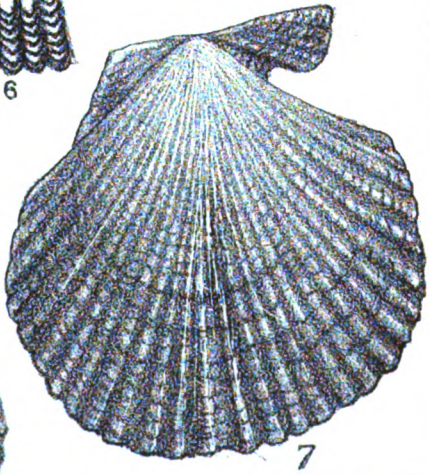


5a

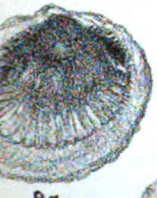


6





7



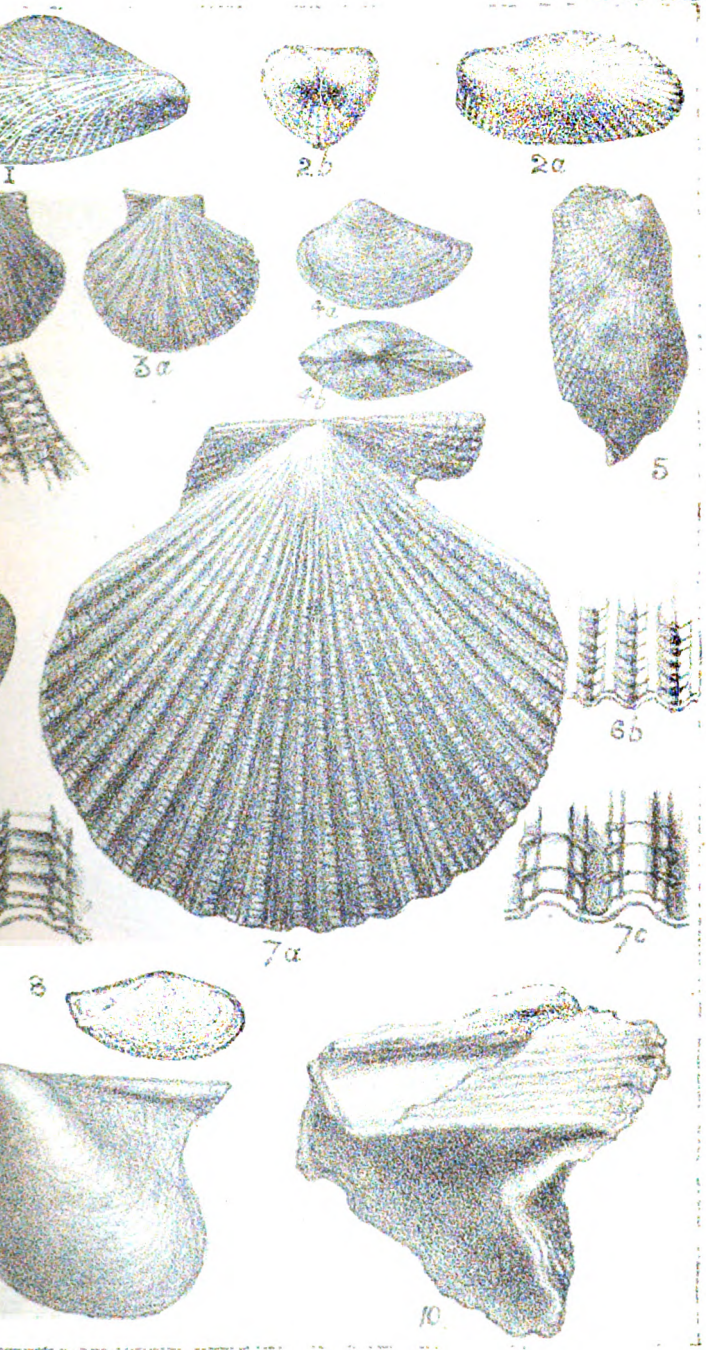
8a

8b

HIDLEY DEL

Digitized by Google

Digitized by Google



TICLEY. DEL

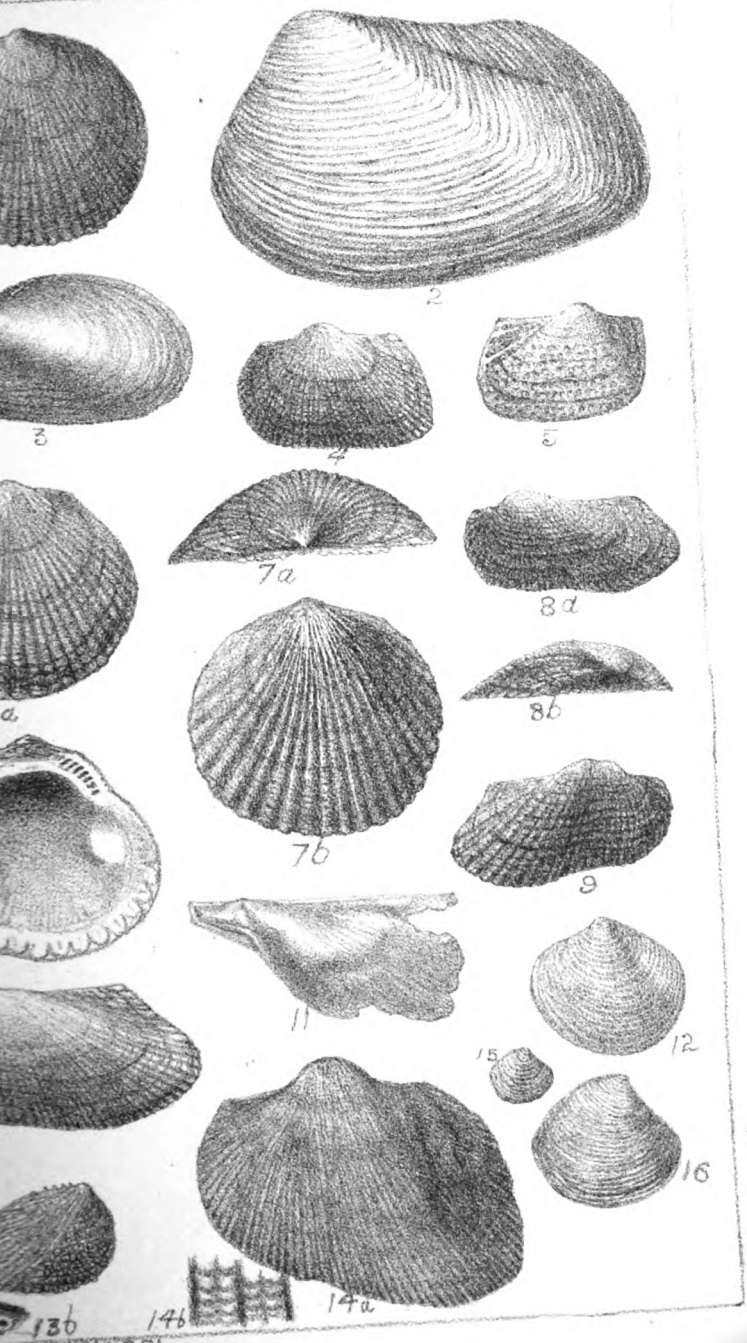
Digitized by Google

Digitized by Google

IDLEY DEL.

Digitized by Google

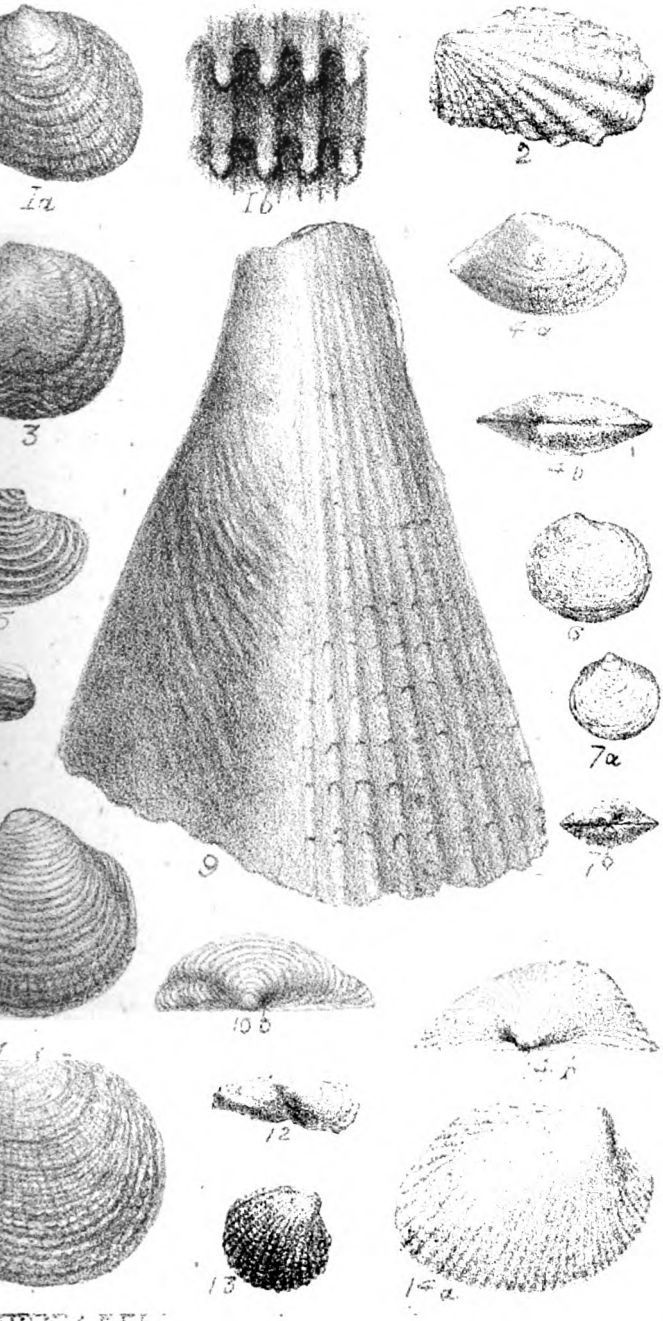
Digitized by Google



HTDLEY DEL

Digitized by Google

Digitized by Google


1a
1b
2
3
4a
4b
5
6
7a
9
10
10b
11
12
13
14a

Digitized by Google

MISCELLANEA.

———o———

The Dasyurus a (?) Vegetarian.

On Friday, January 30, 1885, I saw Mr. F. H. Edwards, lessee of the late Mr. George S. Kingston's estate at Marino, and he informed me (and Messrs. George Laughton and J. T. Fickling) that he had missed a great number of peaches from some of the trees in the garden, and, suspecting that opossums were destroying the fruit, he had some steel traps set beneath the trees. The next morning after setting them his sons brought in a native spotted cat (Dasyurus), which he (Mr. Edwards) opened and examined, and was surprised to find its maw filled with masticated peach-pulp. He afterwards examined others caught in the same manner, and always found the pulp in their stomachs. This being a new fact in natural history has been considered worthy of mention before this Society. The two gentlemen who were with me are intimate with Mr. Edwards, and vouch for the reliability of his statements.

A. Molineux.

Fungi Collected by J. G. O. Tepper about Clarendon, 1882-3.

Identified by Dr. Cooke from specimens sent, viz:—

Agaricus sobrius, *Fries.*
" umbelliformis, *Fr.*
" spumosus, *Fr.*
" quilinus *Fr.*
" tener, *Fr.*
" pediades, *Fr.* (or nearly related species).
" faxiculatus.
Polyporus oblectans, *Berkeley.*
Secotium coarctatum, *Berk.*
Hygrophorus ceraceus, *Fries.*
Clavaria rugosa, *Fr.*
Dacrymyces, sp.

The above are addenda to a list published in the Society's Transactions, vol. vi., p. 68.

Digitized by Google

List of Plants Collected by Chas. Winnecke, Stuart's Range in 1885.

By Baron von Mueller, K.C.M.G., M.D., Ph.D., F.

Ranunculus parviflorus, *Linné.*
Lepidium phlebopetalum, *F. v. M.*
" papillosum, *F. v. M.*
Zygophyllum fruticulosum, *Candolle.*
Plagianthus glomeratus, *Bentham.*
Frankenia lævis, *L.* (several varieties).
Polycnemum diandrum, *F. v. M.*
Ptilotus obovatus, *F. v. M.*
Pimelea simplex, *F. v. M.*
Loranthus pendulus, *Sieber.*
Aster Muelleri, *Sonder.*
Minuria leptophylla, *Candolle.*
Calotis plumulifera, *F. v. M.*
Ixiolæna leptolepis, *Bentham.*
Gnephosis arachnoidea, *Turczaninow.*
Chthonocephalus Pseudevax, *Steetz.*
Angianthus pusillus, *Bentham.*
Podolepis Siemsieni, *F. v. M.*
" canescens, *Cunningham.*
Helipterum pterochætum, *Bentham.*
" moschatum, *Bentham.*
" floribundum, *Candolle.*
" strictum, *Bentham.*
Isotoma petræa, *F. v. M.*
Plantago varia, *R. Brown.*
Nicotiana suaveolens, *Lehmann.*
Dæmia Kempeana, *F. v. M.*
Convolvulus erubescens, *Sims.*
Eremophila scoparia, *F. v. M.*
" Gilesii, *F. v. M.* (corolla blue).
" rotundifolia, *F. v. M.*
" Duttonii, *F. v. M.*
Triglochin centrocarpa, *Hooker.*
Stipa crinita. *Gaudichaud.*
Cheilanthes tenuifolia, *Swartz.*

On the Occurrence of Astrorhiza angulosa as a Fossi the Older Tertiary of Victoria.

In January, 1885, Mr. Henry Watts, of Melbourne, sent a series of fossil Foraminifera for identification. Among t was a slide containing several examples of the above spe

Digitized by Google

and is of some interest as being the first instance in which the genus has been obtained in a fossil condition. The genus was founded by Sandahl for a group of arenaceous Foraminifera built up of very fine sand grains, and takes the form of angular, radiating, or branching masses. *A. angulosa* is one of the deep-sea forms described by Mr. H. B. Brady from the Challenger dredgings. It appears to have a very limited distribution in existing seas. The last-named authority states that the figured specimens of his work "are all from station 78, east of Azores, from a depth of 1,000 fathoms, and except for a single example found in one of the Porcupine dredgings in the North Atlantic at 630 fathoms, this is the only locality at which the variety has been collected." The specimens under notice were found, I believe, at Waurn Ponds, near Geelong, and correspond exactly with the subtriangular specimens figured by Mr. Brady.

W. Howchin, *Ed.*

Australian Fossil Bryozoa.

Mr. A. W. Waters, F.G.S., has published two more valuable articles on the fossil Bryozoa of Australia since our last notice of his work in this department. In Quar. Jour. Geol. Soc., Nov., 1884, he deals with the Cyclostomatous group, and figures several new species from Aldinga, the Mount Gambier beds, and from the Tertiaries of the other colonies. Prof. Tate having sent a large series of Bryozoan remains to Mr. Waters, the result of extensive work in the Aldinga and Murray Cliff sections, and including a few from the Adelaide Government bore, Mr. Waters has described them in *loc. cit.*, Aug., 1885. The collection furnishes no less than 73 species, "of which," Mr. Waters states, "46 are known living, bringing the number of Australian fossil Bryozoa described up to 220, of which just about half have been found living." The former article is illustrated by two plates, and the latter by one.

The full list of species as determined by Mr. Waters from South Australian "Older Tertiary" material is as follows:—

1. Cellaria malvinensis, *Busk.*
2. " angustiloba, *B.*
3. Membranipora aperta, *Busk.*
4. " circularis, *d'Orb.*
5. " Savartii, *Aud.*
6. " radicifera, *Hincks.*
7. " rhynchota, *Busk.*
8. " temporaria, *spec. nov.*
9. " Flemingii, *Busk.*

Digitized by Google

10. Membranipora cylindriformis, *Waters*.
11. " parvicella, *T. Woods*.
12. " Michaudiana, *d'Orb*.
13. " trifolium, *var*.
14. Micropora patula, *Waters*.
15 " perforata, *MacG*.
16. Monoporella crassatina, *Waters*.
17. " sexangularis, *Goldf*.
18. Stenagoporella magnilabris, *Busk*.
19. " Rozieri, *var* indica, *H*.
20. Cribrilina radiata, *Moll*.
21. " figularis, *Johnst*.
22. " terminata, *Waters*.
23. Mucronella mucronata, *Sm*.
24. " nitida, *Verrill*.
25. " coccinea, *var*. mamillata, *B*.
26. " coccinea, *var*. resupinata, *Manz*.
27. Microporella grisea, *Lamx*.
28. " coscinopora, *var*. armata, *W*.
29. " violacea, *Johnst*., *var*. fissa, *W*.
30. " symmetrica, *Waters*.
31. " ferrea, *Waters*.
32. " pocilliformis, *sp. nov*.
33. " (Lunulites) magna, *Woods*.
34. " magnirostris, *MacG*.
35. " elevata, *Woods*.
36. Porina coronata, *Rss*.
37. Lepralia edax, *Busk*.
38. " depressa, *Busk*, *var*. *W*.
39. " rostrigera, *Sm*.
40. " escharella, *Römer*.
41. " burlingtoniensis, *Waters*.
42. " subimmersa, *MacG*.
43. " confinita, *sp. nov*.
44. Smittia Tatei, *T. Woods*.
45. " Landsborovii, *Johnst*.
46. " reticulata, *MacG*.
47. " seriata, *Rss*.
48. " Milneana, *B*., *var*. cœquata, *W*.
49. Schizoporella vulgaris, *Moll*.
50. " simplex, *J*., *var*.
51. " phymatopora, *Rss*.
52. " striatula, *Sm*.
53. " fenestrata, *Waters*.
54. " Cecilii, *Aud*.
55. " protensa, *sp. nov*.
56. Mastigophora Dutertrei, *Aud*.

Digitized by Google

tepora marsupiata, *Sm.*
ynchopora bispinosa, *Johnst.*
llepora coronopus, *Busk.*
" avicularis, *Hincks.*
" costata, *MacG.*
" divisa, *sp. nov.*
" mamillata, *Busk.*
" albirostris, *Sm.*
" pertusa, *Sm.*
" " *var.* ligulata, *nov.*
" biradiata, *sp. nov.*
" tridenticulata, *Busk.*
" fossa, *Haswell.*
" " *var.* marsupiata, *nov.*
xythopora hystrix, *MacG.*
pularia Canariensis, *Busk.*
enaria maculata, *Busk.*

W. Howchin, *Ed.*

---

on Some Mesozoic Plant-Remains from South Aus-
alia. By Henry Woodward, LL.D., F.R.S., F.G.S.,
., (*Geological Magazine, July*, 1885.)

ils from Mount Babbage consist of plant remains
entirely converted into a pure quartzite, and include—

ragment of a small stem considered to belong to the
Cycadeæ and named *Mantellia Babbagensis* (Pl. vii.,
ig. 1-2).

d a badly preserved specimen of *Clathraria* or *Buck-
landia* of the Cycadeæ, but which Mr. W. Carruthers,
F.R.S., considers a fragment of silicified wood bored into
by Teredoes (Pl. vii., fig. 6).

ils from Cutaway Hill, Leigh Creek; these consist
ressions of strap-like leaves and slender stalks of some
le on a block of quartzite, but do not afford sufficient
e for exact determination.

il from Mount Adams consists of a quartzite with an
ion of a palmate leaf (woodcut), suggestive of the leaf
lisburia.

localities of the fossils are mapped as Mesozoic by the
ment Geologist, from whom the specimens were re-

R. Tate.

Digitized by Google

ABSTRACT OF PROCEEDINGS

OF THE

Royal Society of South Australia

FOR 1884-1885.

ORDINARY MEETING, NOVEMBER 4, 1884.

Professor LAMB in the chair.

BALLOT.—A. A. Lendon, M.D.; John Gosse, M.R.C.S., wer elected Fellows; and J. J. East a Corresponding Member.

EXHIBITS.—Mr. Molineux exhibited some insects sent fro Kangaroo Island by W. J. Horswill.

Mr. J. J. EAST forwarded a paper on a geological sectio from the head of St. Vincent Gulf eastward across the basi of the Rivers Wakefield and Light, which was read.

Professor TATE forwarded Remarks on some recent pape upon the "Palæontology of South Australia," which was rea

Mr. F. S. CRAWFORD gave a paper upon the "Shot-ho Disease in Apricot, Almond, and Peach Trees."

ORDINARY MEETING, DECEMBER 2, 1885.

Professor LAMB in the chair.

EXHIBITS.—The skin of *Grallaria pratincola* by Mr. R. H Pulleine. A caterpillar preserved in glycerine by Mr. Pickel Mr. Mestayer pointed out that a solution of chloral-hydra was good for preserving such specimens; and Mr. Tepper re marked that one per cent. of chromic acid added to th glycerine was effectual to prevent softening and shrinkag Mr. J. W. Jones, Conservator of Water, forwarded portio of the core from the bore at Hergott Springs.

Mr. W. HOWCHIN, F.G.S., read a paper on "Some Foss Foraminifera found in the Government boring at Hergott, wit general remarks on the Section and on other forms of Microzo observed therein."

Digitized by Google

Ordinary Meeting, February 5, 1885.

Dr. Whittell in the chair.

Ballot.—Mr. W. A. Jones was elected a Fellow.

Exhibits.—Dr. Cleland showed some fragments of coral found on the surface of a plain fifteen miles north-west of Farina. In reference to this, Mr. Howchin stated that he had been informed by the Conservator of Water that fossils which he (the Conservator of Water) believed to be of Cretaceous age were found close to the surface in that locality, whilst calcareous casts were met with in the boring made in the neighbourhood. A stone showing casts of various molluscs from the bore at Hergott was shown. Dr. Mayo exhibited a lizard (*Œdura rhombifera*), commonly known as the Australian Gecko; also a specimen of *Lactuca saligna*.

Mr. F. H. Edwards, of Marino, wrote, saying that he had trapped some native spotted cats (*Dasyurus*), in the stomachs of which he had found peaches.

A paper by F. W. Andrews was read on the "Nidiology of the *Leipoa ocellata*."

Mr. Tepper showed a new variety of Drosera.

Mr. S. Dixon read a paper on "Some Native South Australian Plants suitable for Cultivation as Fodder."

Mr. Tepper read a paper "On some New and Rare Insects."

Ordinary Meeting, March 3, 1885.

Prof. Lamb in the chair.

Ballot.—Prof. Rennie was elected a Fellow.

Prof. Lamb read a paper on the "Persistency of Electrical Currents in Masses of Iron;" also a paper on the "Cause of Luminosity in Flame."

Prof. Rennie read some remarks on the cause of "Discoloration Observed in certain South Australian Bricks."

Ordinary Meeting, April 14, 1885.

Prof. Lamb in the chair.

Exhibits.—Dr. Stirling exhibited and explained a number of instruments for conducting physiological observations.

Dr. Haacke made observations respecting "Two Remarkable Species of South Australian Fishes;" also concerning "South Australian Rays and Sharks, with special reference to the gravid uterus of the former;" also on the "Colour of Deep-sea Crabs, Boiled Crayfish, and Hermit Crabs;" and "On the gravid uterus of some South Australian Lizards."

Digitized by Google

ORDINARY MEETING, MAY 5, 1885.

Professor LAMB in the chair.

BALLOT.—Mr. Thomas Gill was elected a Fellow.

EXHIBITS.—Dr. Mayo exhibited a specimen of beetle belo
ing to the species *Schizorrhina*. Mr. Tepper laid on the t
a piece of limestone with regular ovate enclosures. Specim
mounted on glass and immersed in spirit, and prepared b
special method of Mr. Zietz, the *preparateur* at the Muse
were shown. They included one of the *Cyanidæ*, an anne
thickly covered with fine long tentacles, a specimen of *Cyd
pileus*, of *Eudendrium rameum*, of *Limax variegatus*, of *Tr
tæniatus* (male and female), and two specimens of *Gecko*.
the exhibits presented a very natural appearance.

Mr. A. W. JONES read a paper upon "Iridiscent Clouds.

ORDINARY MEETING, JUNE 2, 1885.

Professor LAMB in the chair.

BALLOT.—Mr. W. Ernest Cooke, B.A., was elected a Fell

EXHIBITS.—Mr. Howchin showed a piece of hydratid or
of iron from Alice Springs, which had been mistaken fo
meteorite. Dr. Whittell exhibited and explained the use o
new and simple freezing microtome.

Mr. HOWCHIN made some remarks upon a specimen of *As
rhiza angulosa* sent over from Victoria by Mr. Watts,
found by him in the Miocene beds of that colony.

Mr. WRAGGE read a paper on some "Observations made
him during the voyage of the s.s. Maranoa to this colony fr
England."

ORDINARY MEETING, JULY 7, 1885.

Professor LAMB in the chair.

BALLOT.—Mr. R. B. Lucas was elected a Fellow.

Mr. GAVIN SCOULAR forwarded a paper on "Past Clima
Changes in South Australia, with reference to a Gla
Period," which was partly read.

ORDINARY MEETING, AUGUST 4TH, 1885.

Dr. WHITTELL in the chair.

BALLOT.—Dr. Renner was elected a Fellow.

EXHIBITS.—Mr. Tepper brought an Orchid collected
Cape Willoughby by Mr. J. Horswill, apparently new.
also read a list of fungi collected by him in the neighbourh
of Clarendon.

The remaining portion of Mr. SCOULAR'S paper was read.

A criticism on some portions of Mr. Scoular's argument w
forwarded by Prof. TATE and read.

Digitized by Google

ORDINARY MEETING, SEPTEMBER 8TH, 1885.

W. RUTT, C.E., in the chair.

GEO. STYLES, of Port Caroline, wrote respecting cyclones, eir tendency to blow towards a centre, and suggested ller meteorological observations should be published, so e advent of storms might be ascertained.

W. ERNEST COOKE, B.A., made some critical remarks in howing that it was by no means an easy thing to fore- e weather, even with the help of the telegraph.

BEDNALL forwarded a description of species of *Murex* and of the coast of South Australia.

E. GUEST sent a paper on the "Nomenclature and Des- n of some South Australian Butterflies."

unclassified results of a dredging expedition in St. t Gulf were laid on the table.

ANNUAL MEETING, OCTOBER 6TH, 1885.

WHITTELL in the chair.

L. C. E. GEE was appointed to audit the accounts.

ws for the admission of bodies of science-workers, and ir government as Sections of the Royal Society of South lia, were read, discussed, amended, and adopted.

IBITS.—Mr. Tepper showed a very large cocoon densely with silk, which he had found in a mallee-log. The producing it was unknown.

annual report was then read, as follows:—

ANNUAL REPORT.

Council has the honour of reporting that the following have been laid before it:—"Geological Section from d of St. Vincent Gulf eastward across the Wakefield ght River Basins," by J. J. East; "Remarks on Recent upon the Palæontology of South Australia," by Prof. F.G.S.; "Shothole Disease in Apricot, Almond, and Trees," by F. S. Crawford; "Some Foraminifera Found Boring at Hergott Township," by W. Howchin, F.G.S.; Nidiology of the *Leipoa ocellata*," by F. W. Andrews; Native South Australian Plants suitable for Cultivation lder," by S. Dixon; "Notes upon New and Rare ," by J. G. O. Tepper, F.L.S.; "The Persistency of cal Currents in Masses of Iron," by Prof. Lamb, F.R.S.; Cause of Luminosity in Flame," by Prof. Lamb, F.R.S.; s on Discolouration Observed in certain Bricks," by Rennie, D.Sc.; "Two Remarkable Species of South Aus- Fishes," by W. L. Haacke, Ph.D.; "Observations ing South Australian Rays and Sharks, with special

Digitized by Google

reference to the gravid uterus of the former," by W. L
Haacke, Ph.D.; "On the Colour of Deep-sea Crabs, Boile
Crayfish, and Hermit Crabs," by W. L. Haacke, Ph.D
"Observations respecting the gravid uterus of some Sout
Australian Lizards," by W. L. Haacke, Ph.D.; "Iridescen
Clouds," by W. A. Jones; "Scientific Observations mad
during the Voyage of the steamer Maranoa from England t
South Australia," by C. L. Wragge, F.R.G.S.; "Past Climat
Changes in South Australia, with special reference to a Glaci
Period," by Gavin Scoular; "Concerning a Glacial Epoch i
South Australia," by Prof. Tate, F.G.S.; "Some Meteorologic
Observations," by Geo. Styles; "Respecting the Possibility
Forecasting the Weather in South Australia," by W. Erne
Cooke, B.A.; "Description of the Species *Murex* and *Typhis*
the Coast of South Australia," by W. Bednall; "Nomencl
ture and Description of some South Australian Butterflies," b
E. Guest; "The Palliobranchs of the Older Tertiaries," b
Prof. Tate, F.G.S.; "The Lamellibranchs of the Older Te
tiaries," by Prof. Tate, F.G.S.; "Additions to the Flora
South Australia," by Prof. Tate, F.G.S.

The financial statement was made, and showed that the r
ceipts during the year had been £253 4s. 4d., and the expend
ture £201 1s. 11d. The balance at the Bank was £117 2s. 2d
and £250 was placed on deposit. The report and balanc
sheet were adopted.

Election of Officers.—President, H. C. Mais, M.I.C.E
Vice-Presidents, W. Howchin, F.G.S., and R. L. Mestaye
C.E.; Hon. Treasurer, Walter Rutt, C.E.; Hon. Secretary, W
L. Cleland, M.B.; Council, Professor Rennie, H. T. Whittel
M.D., E. C. Stirling, M.D., J. W. Bussell, D. B. Adamson, W
E. Cooke, B.A.

The following papers by Professor Tate were laid on th
table and taken as read:—"The Palliobranchs of the Old
Tertiaries of South Australia," "Additions to the Flora
South Australia." "The Lamellibranchs of the Older Te
tiaries of South Australia."

Digitized by Google

BY-LAWS

Relating to Sections in connection with the Society.

1. With the consent of the Council, Sections may be formed in connection with the Royal Society for the special study of particular branches of natural or applied science.

2. Such Sections shall consist of—

   a. Members of the Royal Society who may desire to join the Section, and shall pay the annual subscription.

   b. Other persons, not being members of the Royal Society, who shall have been regularly elected subscribers to the Section.

3. Members of the Royal Society who may join any of the Sections shall not be required to pay any entrance fee, and the annual subscription to be paid by them shall not exceed one-half of that to be paid by non-members of the Society.

4. The members of each Section shall elect their own Committee of Management.

5. The President and Vice-Presidents of the Royal Society for the time being shall be *ex-officio* members of the Committee of Management of all Sections that may be formed.

6. The rules and regulations for the management of all Sections shall be submitted to the Council of the Royal Society for their approval, and shall not have any effect until they have been formally approved by the Council.

7. Subscribers to the Sections shall have access to the library of the Royal Society, subject to such regulations as may be made by the Council.

8. The Committee of Management of each Section shall on or before 15th September of each year furnish to the Council of the Royal Society an annual report of the proceedings of the Section, with a balance-sheet, for publication (subject to the approval of the Council) in the Society's annual volume. A copy of such report shall be given to each member of the Section whose subscription for that year shall have been paid.

9. Sections shall be allowed the use of the Society's room at such times as may be approved by the Council.

10. All subscriptions received by any Section must be paid to the Hon. Secretary of the Royal Society, any funds required by such Section being supplied by the Parent Society. Sections should be as far as possible self-supporting, but grants of money may be made to any Section by the Council out of the general funds of the Society.

Digitized by Google

THE TREASURER IN ACCOUNT WITH THE ROYAL SOCIETY OF SOUTH AUSTRALIA.

Dr.	£	s.	d.	£	s.	d.
October 1st, 1884.						
To Balance brought forward				314	19	9
Subscriptions—Royal Society	98	8	6			
Field Naturalists' Sec.	18	5	0			
				116	13	6
Government Grant (first instalment)				99	0	10
Interest				12	10	0
Sale of Bookcase				25	0	0
				£568	4	1

Cr.	£	s.	d.	£	s.	d.
By Cost of Transactions—						
Printing and Binding	49	5	9			
Illustrating	36	1	0			
Publishing	4	5	11			
				89	12	8
Subscription to S.A. Institute (nine months)				9	0	0
Salaries, &c.—Assistant Secretary ..	21	0	0			
Attendant	1	7	0			
				22	7	0
Advertising				4	18	11
Printing, Postage, and Stationery ..				23	15	1
Field Naturalists' Section—Grants ..	55	0	0			
Stationery (Postal Microscopical Exchange)	3	14	0			
	58	14	0			
Less Repaid by Section	7	5	9			
				51	8	3
Balance—Bank of South Australia ..	139	16	3			
Savings Bank	250	0	0			
	389	16	3			
Less Outstanding Cheque ..	22	14	1			
				367	2	2
				£568	4	1

Audited and found correct,

Digitized by Google

DONATIONS TO THE LIBRARY

For the Year 1884-5.

I.—Transactions, Journals, and Reports.

Presented by the respective Societies, Editors, and Governments.

Ballarat School of Mines—Annual Report for 1884.

Baltimore—American Chemical Journal. By Ira Remson. Vol. VI., No. 4.

——— Johns Hopkins' University Circular. Vol. IV., No. 41.

——— Johns Hopkins' Third Series "Historical and Political Science;" VIII. "The Influence of the Proprietors in Founding the State of New Jersey."

Batavia—Catalogues des Bibliotheck van de Koninkligke-Natuurkundige Vereeniging in Nederlandsch-Indie.

Belfast—Report and Proceedings of the Belfast Natural History and Philosophical Society for 1883-84.

Berlin—Sitzungberichte der königlich-Preussischen Akademie der Wissenschaften zu Berlin; 1884. Nos. 18 to 39. XXX.-XXXI. and XXXIV.-XXXV.

Boston—Proceedings of the American Academy of Arts and Sciences. Vol. XI., parts 1 and 2.

Bruxelles—La Chronologie Geologique; Discours prononcé à la Séance Publique de la Classe des Sciences de l'Academie Royale de Belgique.

Buenos Aires—Boletin de la Academia Naçional Ciencias en Cordoba (Republica Argentina, Tomo 6, Entregas 2a y 3a.

Cambridge, U.S.A.—Annual Report of the Curator of the Museum of Comparative Zoology at Harvard College for 1883-84.

——————— Bulletin of the Museum of Comparative Zoology at Harvard College, vol. XII., No. 1.; vol. XI., No. 11.

——————— Studies from the Newport Marine Laboratory.

Digitized by Google

Cape Town—Transactions of the South African Philosoph
Society, vol. iii., 1881-83.
Christiana—Den Norske Nordhavs Expedition 1876-78.
Zoologi-Asteroidæ. XII. Zoologi-Penna
lida. XIII. Zoologi-Spongiadæ. Geo
tische Arbeiten, Heft IV. Vandstands
servationer, Heft III. XIV. Zoologi, C
taca, 1a and 1b.
Colorado—The Artesian Springs of Denver. Report by
Special Committee of the Colorado Scien
Society.
Dublin—The Scientific Transactions of the Royal Du
Society, vol. 1, series 2, Nos. 20, 21 (two copi
23, and 25. Vol. 3, series 2, Nos. 1, 2, 3.
——— Proceedings of the Royal Dublin Society, vol. 3,
series; parts 6, 7. Vol. 4, parts 1, 2, 3.
Edinburgh—Proceedings of the Royal Society of Edinbu
Session 1881-82, 1882-83.
——— Proceedings of the Royal Physical Soci
Session 1883-84; vol. VIII., part 1.
Göttingen—Nachrichter von der K. Gesellschaft der Wis
schaften und der Georg.-Augusts. Univers
zu Gottingen, Aus dem Jahre, 1883; No. 1-
Halle, 1881-82-83—Leopoldina. Amptliches organ der Kai
lichen - Leopoldino - Carolinischen-D
schen Akademie der Naturforscher, 18
82-83.
London—Proceedings of the Royal Colonial Institute; vol.
——— Proceedings of the Royal Society; vol. XXXV
Nos. 227 to 231.
——— Journal of the Royal Microscopical Society; Se
II., vol. IV., Part 5, 6; vol. V., Part 1, 2, 3, 4.
——— Transactions of the Entomological Society of Lon
for 1884.
——— Proceedings of Royal Colonial Institute, 1884-5.
Manchester, 1883—Memoirs of the Manchester Literary
Philosophical Society; vols. VII.,
XX., and XXII.
Montreal—Geological and Natural History Survey
Museum of Canada. Report of Progress, 18
83-84 (with forty maps in six sets), separate.
——— Do., do. Catalogue of Canadian Plants; Par
Gamopetalæ.
Munich—Sitzungberichte der mathematische-physicalisc
Classe der Königlich-Bayerischen Akademie
Wissenschaften zu München. 1883-4.
——— Abhandlungen der mathematisch - physicalisc

Digitized by Google

Classe der Königlich-Bayerischen Akademie der Wissenschaften zu München. Denschriften 52, part 1.

ich—Gedächtnissrede auf Theodor L. W. von Bischoff, gehalten in der offentlichen Sitzungder Königlich-Bayerischen Akademie der Wissenschaften zu München, zu Feier ihres einhundert und fünfundzwanzigster Stiftunstages am 28 Marz, 1884. Von Carl Kupffer, O. Mittgleide, mathematisch-physicalischen Classe der K.-B. Akademie.

– Franz von Kobell. Eine Denkschrift, Von K. Haushöfer, a.o. Mitgleid der Königlich-Bayerischen Akademie der Wissenschaften zu München.

Zealand, 1884—Reports of Geological Explorations during 1883-4.

———— Meteorological Report, 1883.

———— Report of the Auckland Institute and Museum for 1884-85.

———— Transactions and Proceedings for the New Zealand Institute, 1884. Vol. XVII.

———— Nineteenth Annual Report of the Colonial Museum and Laboratory for 1883-4.

South Wales—Journal and Proceedings of the Royal Society of New South Wales for 1883. Vol. XVII.; vols. X., XI, and XVIII.

———— Proceedings of the Linnean Society of New South Wales. Vol. IX., parts 3, 4; vol. X., parts 1, 2.

-Bulletin de la Société Académique Indo-Chinoise-Année, 1881.

Archive de la Société Amerique de France. Nouvelle Series; tome II., part 1.

Epreuves pour Corrections et Additions de la Liste Générale des Membres da Congres International des Orientales. 1c. Session; Paris, 1873.

Société Ethnographique. Statuts révisés pas le Coureit et adoptés par l'Assemblie Generale, le 3 Mars, 1879.

Institution Ethnographique: Instructions pour les Délégations. 2c ed.; Revue et Augmenta.

Annuaire de l'Athénée Oriental. Public par Victor Dumas, 1866.

Annuaire de la Société d'Ethnographie, 1881.

Rapport Annuel sur les Recompenses et Encouragements decernes en 1883.

Digitized by Google

Philadelphia—Proceedings of the Academy of Natural Scien
of Philadelphia. Part II., May, Octo
1884. Part III., Nov., Dec., 1885; part
Salem—Annual Report of the Trustees of the Peab
Academy of Sciences, 1874 to 1884.
San Francisco, California—Bulletin of the California Acad
of Sciences, Nos. 1, 2, 3.
St. Louis—Transactions of the Academy of Science, vol.
No. 3.
South Australia—Final Report of the South Australian In
tute for the nine months ended June
1884.
——— Proceedings of Parliament and Papers, 1
vols. I., II., III., IV.
——— Reports on Planting Olives and Mulber
on Mallee Lands in the Far North,
Wattle Cultivation generally in
Colony, by J. E. Brown, F.L.S., &c.
——— Meteorological Observations made at
Adelaide Observatory in 1882, by C
Todd, C.M.G., F.R.A.S., &c.
——— Report on the Post Office, Telegraph,
Observatory Departments, by C
Todd, C.M.G., F.R.A.S., &c.
——— Notes on the Echunga Goldfields, with m
by H. Y. L. Brown, Government Ge
gist.
——— Reports on Geology of Country East
Farina, and Northward to lat. 23°
with map, by H. Y. L. Brown.
——— Report of the Geological Character
Country passed over from Port Aug
to Eucla.
——— Report of Board of Governors Pu
Library, Museum, and Art Gall
1884-5.
Tasmania—Abstracts of Proceedings of the Royal Society
Tasmania on 13th October, 1884.
——— Papers ordered by the Legislature to be printed
Victoria—Victorian Year Book for 1883-4, by H. H. Hay
C.M.G.
——— Statistical Register of the Colony of Victoria
1883—Part IV., Interchange; Part V., Vital,
Part VI., Production, &c.; Parts VII., VIII.,
Index—1884; Pl, Bluebook.
——— Government Statistics, Annual Report on Vital
tistics of Melbourne and Suburbs, 1884.

Digitized by Google

Victoria—Australasian Statistics, 1883.
—— Sixth Annual Report of the Proceedings of the Government Statist in connection with Friendly Societies.
—— Part II. (1884), Population; III., Finance, &c.
—— Southern Science Record, New Series, January, 1885, 1, 2.
—— The Victorian Naturalist, vol. I., No. 11; vol. II., Nos. 2 and 3; Nos. 4, 5, 7.
—— Australasian Scientific Magazine, No. 1, vol. I.
—— The Australasian Journal of Pharmacy, vol. I., No. 1.
—— Transactions and Proceedings of the Royal Society of Victoria, vol. XXI.
—— Russell's Map of Early Melbourne, from Public Library of Melbourne.
—— Agricultural Statistics to March, 1885.
—— The Victorian Naturalist, vol. I., No 11; vol. II., No. 2.
—— Results of Astronomical Observations at the Melbourne Observatory for 1876 to 1880 inclusive.
Vienna—Kaiserlich Akademie der Wissenschaften in Wien, Sitzung der Mathematisch-naturwissenschaftlichen Classe. Nos. 20 to 27, 1884; 28, 1885; and 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 14, 15, 16.
—— Beiblatt zu den Mittheilungen des Ornithologischen Vereines in Wien, 1884; Nos. 6 to 25.
—— Mittheilungen des Orinithologischen Vereines in Wien, 1885; Nos. 8 to 12; Nos. 1 to 7.
—— Verhandlungen der K. K. Geologischen Reichsanstalt, 1884.
—— Mittheilungen des Ornithologischen Vereines in Wien, 2 Jahr; Nos. 1 to 25; Section für Geflurgetzucht und Brieftaubenweisen.
Washington—Report of the U.S. Geological Survey of the Territories; vol. VI.
Do. do. Mineral Resources of the United States.
———— Annual Report of the Board of Regents of the Smithsonian Institute for 1882.
Wurzburg—Sitzungberichts der Physicalisch-Medicinischen Gesellschaft zu Würzburg, Jahrgang, 1884.

Digitized by Google

II.—Books and Pamphlets.

(Names of donors in italics.)

Australian Museum Governors—List of Old Documents
Relics in the Austral
Museum.

Bale, W. M.—Catalogue of Australian Hydroid Zoophytes.

Brazier, John—The Synonomy of and Remarks on the Spec
Names and Authorities of Four Species
Australian Marine Shells.

———— On some recent Shells found in layers of c
on the Macleay Coast, New Guinea.

———— Critical List of Mollusca from North-W
Coast of Australia.

Browne, H. J.—The Higher Sciences; or, Materialism Refu
by facts.

Hutton, F. W.—The Origin of the Fauna and Flora of N
Zealand.

Institution d'Ethnographie—L'âme Humaine au Point de
de la Science Ethnographique

Lamb, H.—History of Electrical Magnetism.

———— On the Induction of Electric Currents in Cylind
cal and Spherical Conductors.

———— On the Mutual Potential of Two Lines in Space

Liveridge, A.—On the Chemical Composition of certain Roc
N.S.W.

———— On some New South Wales Minerals.

Mueller, Baron F.—Eucalyptographia; Tenth Decade.

———— Second Annual Supplement to the Sys
matic Census of Australian Plants.

Putman, C. E.—Elephant Pipes at the Museum, Davenpo
Iowa.

Rosney, Léon—Vocabulaire de l'écriture Niératique Yucatèqu

Russell—Map of early Melbourne.

Selwyn and Dawson—Descriptive Sketch of the Physic
Geography and Geology of t
Dominion of Canada.

Stirling, James—Notes on the Meteorology of the Australi
Alps.

Tolmie, W. F.—Comparative Vocabularies of the Indian Trib
of British Columbia, with maps.

Topley, William—The National Geological Surveys of Euro

Tyron, W.—Manual of Conchology.

Woodward, H. P.—Reprint of Papers from the "Geologic
Magazine."

Digitized by Google

LIST OF FELLOWS, MEMBERS, &c.

NOVEMBER, 1885.

Those marked (F) were present at the first meeting when the Society was founded. Those marked (L) are Life Fellows. Those marked with an asterisk have contributed papers.

		Date of Election
HONORARY FELLOWS.		
Angas, Geo. French, F.L.S., C.M.Z.S.	London	1879
Barkley, Sir Henry, K.C.M.G., K.C.B.	.. .. ..	1857
Ellery, R. L. J., F.R.S.	Melbourne	1876
*Garran, A., LL.D.	Sydney	1853
*Hull, H. M.	Hobart	1855
Jervois, Sir W. F. D., K.C.M.G., C.B.	New Zealand	1878
Little, E.	.. .. ..	1855
Macleay, Hon. W., F.L.S., ..	Sydney	1878
*Mueller, Baron F. von, K.C.M.G., F.R.S.	Melbourne	1879
Russell, H. C., B.A., F.R.A.S., ..	Sydney	1876
Warburton, Col. P. E., C.M.G. ..	Beaumont	1858
*Woods, Rev. J. E. T., F.L.S., F.G.S.	Sydney	1877
CORRESPONDING MEMBERS.		
Bailey, F. M., F.L.S.	Brisbane	1881
Canham, J.	Stuart's Creek	1880
Chandler, T.	Peake	1881
*Cloud, T. C., F.C.S.	Wallaroo	1881
*East, J. J.	Mallala	1884
*Foelsche, Paul	Palmerston	1882
Goldstein, J. R. Y.	Melbourne	1880
*Hayter, H. H., M.A., C.M.G., F.S.S.	Melbourne	1878
Holtze, Maurice	Palmerston	1882
*Kempe, Rev. J.	Finke	1880
*Richards, Mrs. A.	Port Augusta	1880
*Scoular, Gavin	Smithfield	1878
*Stirling, James, F.L.S.	Omeo	1883
FELLOWS.		
*Adamson, D. B.	Adelaide	1867
Abbott, A. G.	Kingston	1884
Angas, J. H.	Angaston	1874
Beresford, D. J. D.	Adelaide	1884
Black, A. B.	Adelaide	1882
Boettger, Otto	Adelaide	1884
Brown, J. E., F.L.S.	Adelaide	1882
Brown, L. G.	Two Wells	1882
Browne, H. Y. L., F.G.S.	Adelaide	1883
Bruer, J.	Adelaide	1883
Brunskill, Geo.	Morgan	1878
Burchell, F. N.	Adelaide	1881
Bussell, J. W.	Adelaide	1884

Digitized by Google

*Campbell, Hon. Allan, M.L.C., L.R.C.P. Edin.	Adelaide	188
Caterer, T. A., B.A.	Norwood	188
*Chalwin, Thos., M.R.C.V.S. Eng.	Adelaide	187
Chapple, F., B.A., B.Sc.	Prince Alfred College	187
*Cleland, W. L., M.B., Ch.M., F.R.M.S.	Parkside	187
*(L) Cooke, E.	Adelaide	187
*Cooke, W. Ernest, B.A.	Adelaide	188
Cox, W. C.	Semaphore	188
Cornish, W. H.	Adelaide	188
*Crawford, F. S.	Adelaide	186
*Davenport, Sir Samuel	Adelaide	184
Davies, Edward	Adelaide	188
Davis, F. W.	Adelaide	188
Dobbie, A. W.	Adelaide	187
Elder, Sir Thomas	Adelaide	187
Evans, Thomas	Adelaide	188
Farrar, G. E.	Adelaide	188
*Fletcher, Rev. W. R., M.A.	Kent Town	187
Foote, H.	Outalpa	188
Fowler, W.	Kulpara	188
Gall, David	North Adelaide	186
Gardner, Wm., M.D., C.M.	Adelaide	186
Gee, Lionel, C. E.	Adelaide	188
Giles, G. F.	Adelaide	186
Gill, George	Adelaide	188
Gill, H. P.	Adelaide	186
Gill, Thomas	Adelaide	188
Gosse, John, M.R.C.S.	Wallaroo	188
*Goyder, Geo., jun	Adelaide	18
Grundy, E. B.	Adelaide	18
*Haacke, Wm., Ph.D.	Adelaide	18
*Harris, C. H.	Adelaide	18
Harrold, A. L.	Adelaide	18
*Haslam, John	Adelaide	18
Hay, Hon. A., M.L.C.	Adelaide	18
Henry, A., M.D.	Adelaide	18
*Hill, W.	Mitcham	18
Hopkins, Rev. W.	Adelaide	18
*Howchin, W., F.G.S.	Goodwood East	18
Hughes, H. W.	Booyoolie	18
*Hullett, J. W. H.	Port Augusta	18
Johnson, J. A.	Adelaide	18
*Jones, W. E.	Parkside	18
*(F) Kay, R.	Adelaide	18
Kelly, Rev. Robert	Mount Barker	18
Knevett, S.	Adelaide	18
*Lamb, Prof., M.A., F.R.S.	England	18
*Laughton, E.	Adelaide	18
Lendon, A. A., M.D.	Adelaide	18
*Lloyd, J. S.	Adelaide	18
Magarey, A. T.	North Adelaide	18
*Magarey, S. J., M.B.	Adelaide	18
Mais, H. C., M.I.C.E.	Adelaide	18
*Mayo, Geo., F.R.C.S.	Adelaide	18
Mayo, G. G.	Adelaide	18
Mestayer, R. L., F.R.M.S.	Adelaide	18
*Meyrick, E., B.A.	Sydney	18

Digitized by Google

on, W. J. E.	Kangarilla	..	1882
J. H.	Crafers	..	1883
ix, A.	Kent Town	..	1880
ay, Hon. David, M.L.C. ..	Adelaide	..	1859
, H. S.	Adelaide	..	1884
, W. Peel, M.B.	England	..	1880
W. L.	Adelaide	..	1884
, M. P., M.R.C.S.	Port Victor	..	1884
Thomas, C. E.	Port Adelaide ..	..	1883
, W. H.	Adelaide	..	1883
W. E., F.R.M.S.	Adelaide	..	1883
, B., M.D.	Adelaide	..	1883
R. J.	Adelaide	..	1882
on, R., F.F.P.S.	Adelaide	..	1882
Prof., D.Sc., F.C.S. ..	Adelaide	..	1885
, F. E., M.D.	Carrieton	..	1885
, William	Port Adelaide ..	..	1879
Valter, C.E., ...	Adelaide	..	1866
Hon. M., M.L.C.	Adelaide	..	1866
burgk, R., Ph.D.	Adelaide	..	1865
n, Stirling, B.A.	Adelaide	..	1882
n, Thos. D.	Mount Barker ..	..	1857
E. Mitchell	Adelaide	..	1883
R. Barr	Adelaide	..	1871
C. B.	Adelaide	..	1884
J. Y., B.A., B.E.	Norwood	..	1882
H. Y.	Glenelg	..	1878
E.	Adelaide	..	1884
, E. C., M.D., F.R.C.S., M.P.	Adelaide	..	1881
, J. J., M.A.	Adelaide	..	1878
rof. R., F.G.S.	Adelaide	..	1876
s, J. D., M.D.	Adelaide	..	1877
William	Woodville	..	1878
s, W. H.., F.R.G.S. ..	Millswood	..	1881
J. G. O., F.L.S. ..	Norwood	..	1878
Charles, C.M.G., F.R.A.S. ..	Adelaide	..	1856
. W.	Adelaide	..	1882
aum, C.	Adelaide	..	1879
A. K.	Mount Gambier ..	..	1883
. C., M.D.	Adelaide	..	1878
, G.	Meadows	..	1868
W. L.	Adelaide	..	1878
right, E. H., B.Sc.	St. Peter's College	..	1883
, Rev. John	Parkside	..	1884
. W., M.B.	Adelaide	..	1879
. J., Chief Justice	Adelaide	..	1859
r, F.	Adelaide	..	1884
R. A.	Adelaide	..	1882
g, J. B.	Adelaide	..	1882
ll, H., M.D., F.R.M.S. ..	Adelaide	..	1882
ard, H. P., F.G.S.	Adelaide	..	1883
, C. L., F.R.G.S.	Adelaide	..	1877
Wm., M.R.C.S.	Burnside	..	1859
Wm., M.A.	Hindmarsh	..	1880

ASSOCIATES.

ll, D.	Adelaide	..	1883
n, Mrs.	Port Victor	..	1884

Digitized by Google

APPENDIX.

PROCEEDINGS

OF THE

Field Naturalists' Section of the Royal Soc

1884-85.

RULES OF THE FIELD NATURALISTS' SECTIO

1. The general management of this Section shall be controlled Chairman, two Vice-Chairmen, a Secretary, and a Committee of eigh to form a quorum.

2. The Chairman, Vice-Chairmen, and Committee shall be elected annual meeting in October.

3. The Chairman shall not be eligible for office for more than tw secutive years, and one of the Vice-Chairmen shall retire each year.

4. Candidates for admission, not being members of the Royal So must be proposed and seconded by two members of the Section a meeting, and be balloted for at the next ensuing meeting; one blac in five to exclude.

5. Evening meetings shall be held on Tuesdays, at the discretion Committee of Management, for the purpose of reading papers, dealin the natural history of Australia (more particularly of the neighbourh Adelaide), or for the purpose of mutual instruction.

6. There shall be at least eight Field Meetings during the year; th and place to be arranged by the Committee.

7. At the annual general meeting a statement of accounts shall b mitted by the Secretary and duly certified by two auditors appointed previous ordinary meeting, preparatory to being handed to the Treasu the Royal Society.

8. The Section may from time to time elect as honorary members who have been proposed and seconded in the usual way, and have unanimously elected by ballot. This shall also apply to corresp members.

9. Any member owing the subscription to the Section and neglect pay the same on or before the first day of January, shall be liable t his name removed from the list of members of the Section; provided that written application for the same shall first have been made by behalf of the Treasurer of the Royal Society; and, provided also, th Committee shall have power to restore the defaulter's name at his re after payment of arrears.

10. The rules and regulations of the Section shall not be altered u

Digitized by Google

notice of motion, signed by not less than five members, be given at g of the Section; and thereupon such motion may be brought for- the next meeting.

ny resolution passed under rule 10, altering or repealing the rules of on, shall be in force until the meeting held in the month of October g; and if not then confirmed, shall thereafter be held void and of .

n the written requisition of twenty members, delivered to the Secre- extraordinary general meeting may be called to consider and decide e subject mentioned in the requisition.

ne Committee shall be empowered to frame rules for the conduct of ns arranged for by them.

llows of the Royal Society who are members of the Field Natural- tion shall pay to this Section an annual registration fee of one each.

LATIONS OF THE ROYAL SOCIETY FOR THE FIELD NATURALISTS' SECTION.

is Section is established to promote the practical study of Natural by affording fuller opportunities and facilities for meeting and together.

e Section shall consist of—

(*a*) Fellows and Associates of the Royal Society who shall have signed the rules of the Section.

(*b*) Ladies and gentlemen, not members of the Royal Society, who shall become subscribers to the Section.

e members of the Section shall elect their own Committee of nent.

bscribers to the Section shall pay annually, in advance, five shil- ne year to terminate on the 31st day of October.

bscribers to the Section shall have access to the Library of the and shall be entitled to a copy of the "Miscellaneous Contributions al History" and the "Annual Reports" published by the Society for ent year.

e Committee of Management shall furnish to the Honorary Secretary oyal Society an annual report of the proceedings of the Section in publication in the Royal Society's annual volume.

application to the Council of the Royal Society grants of money made to the Section out of the general funds of the Society.

S FOR THE CONDUCT OF FIELD EXCURSIONS.

ch member shall have the privilege of introducing two friends, vilege not to extend to any person who shall have been a visitor at essive meetings.

Chairman to be elected as at ordinary meetings.

e Secretary to act as conductor, or in his absence, some member of mittee nominated by him.

change to be made in the programme, or extra expense incurred, y the consent of two-thirds of the members present.

fees, gratuities, or other expense to be paid except through the or.

ery member or visitor to have the accommodation assigned by the

Digitized by Google

conductor. Where accommodation is limited, consideration will be giv
priority of application.

7. Accommodation cannot be supplied unless tickets are obtained
the time mentioned in the special circular.

8. Those who attend an excursion without previous notice will be
to extra charge, if extra cost be thereby incurred.

9. No intoxicating liquors shall be provided at the expense of the Se

EXCURSIONS.

First Excursion—Monday, November 10, 1884.—Go Grove, &c.

About fifty ladies and gentlemen proceeded on this dat coach to Golden Grove, Bishop's Springs, and the gorg the Little Para River. On arrival at Bishop's Sprin meeting was held, at which five new members were ele and votes of thanks passed to the Right Rev. C. A. Rey and Mr. John Robertson, J.P., for their courtesy in permi members of the Section to make use of their grounds. Tate then addressed the party, and said he was glad to himself of the opportunity of explaining to the members of the salient rock features of the locality. They consist thickly-bedded sandstones and grits forty to sixty feet t and intercalated among clay slates. There were four of bands, and where they were intersected by the stream-co they formed waterfalls. They were traceable on the surfa colossal walls, and on the elevated grounds appeared at a tance like Cyclopean ruins. From their moderate dip an varying slopes of the ground, and the presence of two waterways, the outline on the surface of the grit bands what resembled a collection of the letters V and W, al verted, and altogether afforded very interesting exampl the chief phenomena of stratification. These bands, w had previously been supposed to be of igneous origin, had proved by Mr. Scoular, who had studied them at this neighbouring places, to be of sedimentary origin, some evide of which (such as the lamination of the lower part of the g were observable in the sections examined by the party. position of these bands, in addition to forming a waterfall caused a deflection of the stream which flowed along the for several hundred yards, by which a long mural line of is maintained. This was the habitat of a rare plant in southern portions of the colony, the *Scleranthus pungens*. Professor indicated that a botanical feature was noticeab connection with the grits, viz., the prevalence of the she (*Casuarina quadrivalvis*), and explained that even where grits did not form any marked outcrop, their presence wa

Digitized by Google

determined by the existence of this forest tree, espe-
n the broad belt of timber that crowned the main road
hing Golden Grove. The graceful poison-berry tree,
rum phillryæoides, is here exclusively confined to the same
in this locality. *Bulinus texturatus* was collected in the
The habitat of the *Quinetia Urvillei*, a very rare annual of
ustralian origin, discovered here some years ago by Pro-
Tate, was visited. Here *Ptilotus erubescens* was found;
en the scrub at Golden Grove was explored, but the
floral productions for which it is famous had now
passed away. A few, however, remained, among which
aviesia ulicina, var. *ruscifolia*, and the grass *Amphipogon*
The Professor explained that the surface drainage
e scrub had in the course of a few years cut for itself a
some yards in width, and of a depth of twenty feet
ands and clays which overlie the sandstones and stiff
eous beds of the "Upland Miocene." The same beds
so visible in the roadside cuttings, where the horizontal
ment of these sandstones are unconformable to the
f the old rocks. The peculiar vegetation of these
nds was at this place clearly seen to be referable to this
cal phenomenon.

EXCURSION—THURSDAY, JANUARY 1, 1885.—URAIDLA.

t thirty members and friends of the Section proceeded
dla via Norton's Summit. On arrival at Uraidla the
ere met by Mr. Grasby, of Oakbank, and Mr. Wilson,
aidla, who courteously volunteered their services as

r walking for about a mile a meeting was held—Mr. W.
vay, jun., presiding—and two new members elected, and
y vote of thanks passed to Mr. Wilson. The party
escended to the foot of a waterfall at the head of a
ul glen.

r lunch the walk was commenced, and on the way
on was directed to the undulated foliation of the slates
artzitic grits wherever exposed in the rocky walls bor-
the deep gullies along which the road lay, and which
oduced by lateral pressure. The talcose slates generally
the lower portions of the hillsides, while the quart-
ominate the ridges, which are usually occupied by
ingybark forests. It was pointed out that the configur-
f the country, inclusive of almost equi-distant secondary
gullies, was due to erosion by the agency of rain upon
of different densities. The formation was the same as
rmerly observed at Crafers and the neighbourhood of

Digitized by Google

Mount Lofty, which was composed of rocks of pre-Silu age, concealed mostly by soil formed by their disintegrat and, so far as known, devoid of fossils. There was much was interesting in the botanical features of the trip, and Tepper indicated that as the elevation above the level of plain increased the vegetation changed considerably in ch ter. Near the foot of the rise the peppermint gum, *Eucaly odoratus*, was met with, reaching to a height of more 1,000 feet above sea level, where *E. leucoxylon* (blue g took its place; this at a height of 1,300 or 1,400 feet b succeeded by the two stringybarks *E. obliqua* and *E. capitel* In the stringybark level were found in flower *Leptosper myrsinoides* and *Gompholobium minus*. The latter is gener yellow, but a brilliant red specimen was also found. *Cand graminifolia*, with its sensitive style, the climber *Marian bignoniaceus*, *Aster Sonderi* (flowers pure white, and about inches across), *A. Huegelli* (both purple and white), *Comesp calymega*, were also gathered. In the highest elevations *Brunonia australis*, *Pultenea villifera*, and a few late specir of the orchid *Dipodium punctatum*. The two sedges *Le spermum carphoides* and *L. filiforme* were found on the leading to Norton's Summit. *Eryngium rostratum*, with flowers almost hidden in a curious spray-head of foliage, large white flowers of *Pimelea octophylla* and *P. glauca*, also found. At the foot of the waterfall were fine specir of *Veronica Derwentia*, about six feet high, with conical sp of white flowers, and *Epilobium tetragonum*, var. *pallidum*, long pale pink flowers. The ferns *Lomaria discolor*, *L. cape Adiantum æthiopicum*, and *Osmunda* (*Todea*) *barbara* were ting their spores. Amongst a large number of plants in f were *Daviesia corymbosa*, *D. ulicina*, and *D. brevifolia*; *St housia* sp., *Dillwynia hispida*, *Xerotes sororia*, and two c species.

THIRD EXCURSION—SATURDAY, JAN. 24, 1885.—AMBLES

About forty ladies and gentlemen left by the 1.10 train Ambleside, and on arrival there a start was made for the ba of the River Onkaparinga. After a meeting, under the p dency of Professor Tate, at which four new members elected, Mr. E. Guest led the way northwards. In spit the lateness of the season, the district was rich in botan specimens.

Among the plants found were *Opercularia ovata*, *Me gracilis* and *M. australis*, *Hypericum japonicum*, *Alternant triandra*, *Brachycome graminea*, *Epilobium tetragonum*, *E gonum minus*, *Myriophyllum variifolium* and *M. elatino*

Digitized by Google

geton obtusifolius, *Helichrysum rutidolepis*, and *Poten-serina*. This last is said to be found only in this imme-ocality. Mr. Tepper was fortunate to discover *Haloragis hylla*, distinguished by its digitate leaves. The tall by the riverside — *Bursaria spinosa*, *Leptospermum um*, and *Acacia retinodes*—were in full flower. *Lythrum a*, with its purple flowers, was also gathered.

he sedges collected, the most noteworthy were *Cyperus* *C. textilis*, *Juncus planifolius*, *J. prismatocarpus*, *J. ius*, and *Scirpus inundatus*. Of grasses, the tall *Poa sa* was found in fruit, together with *Echinopogon ovatus ragrostis Brownii*, and *Ehrharta stipoides*. On the rail-ie *Hæmarthria compressa* was seen in flower, and varie-the aquatic plant, *Triglochin procera*, were in full

party followed the Onkaparinga as far as the railway and then returned to the station, which was left at ie city being reached shortly after 6 o'clock.

H Excursion—Saturday, Feb. 14, 1885.—Largs Bay.

members assembled at the North-terrace Railway Station er hour than usual, and proceeded to Largs Bay. On there Mr. J. G. O. Tepper presided over a business g, at which two new members were elected. He then iced Mr. W. T. Bednall, who had consented to act as

Bednall explained that the weather had scarcely been ive to the chance of finding many good marine specimens, careful search the members might add something valu-their collections. He pointed out that the *Venus scala-*he common cockle) was the predominant shell in this , its distribution being very local and confined from Bay to about a mile south of the Semaphore. From there ards this shell was replaced by another sand-living bi-the *Mactra polita*, only a very few specimens of which aken. Mr. Bednall then suggested a number of other of shells that might be found; but, as he intimated at he result of the searching was not particularly inter-

r being advised to collect the sand and small shells would be found in little heaps, and to dry it for exami-under the microscope, when there would probably be ered beautiful specimens of small shells, diatoms, foram-, and corallines, the party took a northerly direction the beach.

Digitized by Google

During the journey Mr. Tepper explained that there w
distinction between the submarine flowering plants and seaw
The plants *Cymodocea antarctica* and *Posidonia australis*, foun
such large quantities on the beach, were commonly mistaken
algæ (seaweed). The difference shown in the appearance of
seaweed and the seaplant was very marked; but the distinc
in classification seemed to be rather finely drawn. A g
specimen of *Halophila ovalis* (marine plant) and some ot
were shown, but nothing worth mentioning was found in a
probably because the attention of the members seemed t
confined to the shells. Very few specimens were taken a
but a fairly good collection was made of *Triton Quoyi*, *N*
fasciata, *Columbella Lincolnensis*, *Natica conica*, *Sigar*
zonalis, *Conus rutilus*, *Bittium turritella*, *Mactra pura*, *Hia*
biradiata, *Arca lima*. Only broken specimens of *Pecten*
tralis, *P. bifrons*, and *P. laticostatus* could be obtained by
a casual examination. *Solemya australis* was uncomm
abundant, but small and in parts only. *Phasianella bulimo*
(pheasant shell) was rather scarce. Mr. Molineux obta
one of the latter alive, which he explained had, by the app
ance of the shell, evidently at some time been attacked
stingray, but eluded the enemy. The shell had been bro
and had grown again with an additional patch on the outs
which was not an infrequent occurrence. Much interest
imparted to the excursion by little dissertations upon
habits of land and marine life, in many cases a very comp
comparison being made.

FIFTH EXCURSION—SATURDAY, MARCH 7, 1885.—BRIDGEWA

The party arrived at Bridgewater about 2.30, where
were met by Professor Tate, and started to walk down C
Creek, along which they proceeded for about a mile. On
way were seen the creeper *Marianthus bignoniaceus*, and
native fuchsia, *Correa decumbens*, with yellow as well as
flowers. Along the banks of the creek was discovered
handsome sedge, *Cladium Mariscus*. The blue-bell, *Wahlen*
gia gracilis, was found in abundance, and it was stated that
plant had been exhibited at the Royal Agricultural Show
fodder-plant, whereas if not poisonous it was at least very
wholesome. *Lobelia microsperma*, which plant is stated to
caused the death of much valuable stock, was noticed,
was also the white everlasting, *Ixodia achilleoides*, a flo
peculiar to the Mount Lofty Ranges and the South-east Des
The bright *Goodenia ovata* was very plentiful.

The party eventually arrived at a waterfall, the basi
which is enclosed on three sides with high rocks. Profe

Digitized by Google

Tate explained that the higher ground here was composed of grits and friable sandstones, while the hard grits made up the valley bottoms. The "potholes" on the face of the rocky bed forming the rapids were stated to have been caused by stones being caught and retained by the eddying current until holes were worn into the rock.

On the return from the waterfall Professor Tate pointed out the curious parasite, *Cassytha pubescens*, festooning *Acacia retinodes*, and drew attention to the sedge *Cladium psittacorum*, the tallest of its kind in Australia. At five o'clock the Section left Bridgewater, and reached the city shortly after six.

SIXTH EXCURSION—APRIL 6, 1885 (EASTER MONDAY).—HIGHERCOMBE.

About thirty-five members and friends proceeded to Highercombe, the party being led by the Rev. J. McEwin. On approaching the hills the different character of their vegetation, some giving light and others a dark tinge, was pointed out. This was explained to be due to the habitat, chiefly determined by the soil and underlying rocks; the dark hills (on which grew shrubs and sedges) being formed of sandstones and other silicious rocks, while the light-tinted hills, which were mostly covered with grass, were composed of shales and slates. The superposition of the Tertiary clays and gravels upon the older rocks at the foot of the hills was also pointed out. The Eucalypti were also noticed to differ from those further south.

On arriving at Highercombe the party visited the beautiful gardens and grounds of the Hon. R. D. Ross, who very kindly granted permission to inspect his property, the chief feature of which was the number of English forest trees. After luncheon the Hon. R. D. Ross led the party to a picturesque gorge, which was about fifteen feet wide, its perpendicular rocks rising some 200 feet above the river. After leaving the gorge and following up the creek back to the gardens, there were found *Callistemon saligna*, *Leptospermum lanigerum*, forming dense thickets, among which were found *Correa decumbens*. A tuft of *Andropogon lanigerum* was also found, and some rare mosses and lichens on the rocks; the latter consisted of quartzose and talcose schists and shales, inclined at rather high angles.

The season being so far advanced, very few flowers were observed. On the way back from the gorge the party visited the "Echo," a face of rock rising some 300 feet above the river.

The coach was reached about five, and the party, after par-

Digitized by Google

taking of Mr. Ross's hospitality, left at 5.30, the home route being *viâ* Anstey's Hill and through Paradise.

SEVENTH EXCURSION—APRIL 18, 1885.—SECOND GULL

About twenty members and friends proceeded to Burn Mr. G. Collis, Jun., acting as Secretary, and Mr. J. C Tepper, F.L.S, and Mr. W. Howchin, F.G.S., being scientific instructors. Shortly after leaving the tram atte was called to a peculiar hard and coarse conglomerate ex on the bank of the creek. Mr. Howchin expressed the op that it was an ancient remnant of the gravel of the local w course, when the stream flowed at a considerably higher The party then ascended the Greenhill, where two very di varieties of *Vittadinia australis* were pointed out. Mr. T directed the attention of the members to the distinct zon Eucalypts. The relation of the vegetation of the hills t rocks of which they were composed was referred to in ord show that from the aspect of vegetation conclusions as t prevailing but hidden rocks could be drawn, just as fro known existence of certain rocks the character of the p could be inferred.

The view from the top of the hill having been admired gully below them, with its steep scrubby declivities and pendicular weathered cliffs was the object of attra On the steep side of the Greenhill some bushes of the African *Gomphocarpus fruticosus* were found perfectly ralised. The dicœcious character of the sheaoak (*Casu quadrivalvis*) was pointed out, and the junction of the species of grasstrees (*Xanthorrhœa semiplana* and *X. quadr lata*) was well shown at one place, the former extending the spot downwards and the latter upwards. In the b Slape's Gully Mr. Tepper pointed out a native grass (*Eh stipoides*) as being eminently suitable for lawns. The *E impressa* was found to be just in bloom, other plants in being *Wahlenbergia gracilis* (bluebell), *Oxalis corni* (yellow), *Styphelia Sonderi* and *S. humifusa*, *Scævola micro Bursaria spinosa* had but few flowers, but more fruit. Th lowing ferns were noticed:—*Cheilanthes tenuifolia*, *Gra rutæfolia*, *Lomaria capensis*, *Asplenium flabellifolium*, and early specimens of Maidenhair (*Adiantum æthiopicum*).

EIGHTH EXCURSION—SATURDAY, MAY 16, 1885.—PORT C

Owing to the threatening weather only a few me attended this excursion. On arrival at Alberton the

Digitized by Google

led under the guidance of Professor Tate in a southerly
on, and shortly after crossing the Port-road struck a
for the Port Creek. A short business meeting was held
, and a new member elected. On nearing the creek
on was called to the *Scirpus nodosus*—a rush-like sedge,
ts of which bind the drifting sand. On reaching the
ts, the tide being low, a good opportunity was afforded in
ng for molluscs under the salsolaceous bushes. Here were
Ampullarina Quoyana, *A. fragilis*, and *Pomatiopsis stria-*
nd the following plants in flower:—*Atriplex semibaccata*,
dosa, *Kochia brevifolia*, *Frankenia lævis*. Further inland
manent pool of water was visited, and proved to be
ngly rich in molluscan life, amongst which were
of *Bittium*, *Tatea*, *Bythinella*, *Trochocholea*, &c., these
ntangled in tow-like confervæ. Several *Isopods* and other
eans were also found. In the same water were seen
sea anemones of a brown colour, with dark bands across
tacles, their existence in this locality causing consider-
tonishment. The following plants were met with on
ndhills:—*Wahlenbergia gracilis*, *Erechtites quadridenta*,
kali, and *Xerotes effusa*. The mangrove (*Avicennia*
lis) was observed to be in flower.

NTH EXCURSION—MONDAY, MAY 25, 1885.—MARINO.

e fifty members and friends started by the 9.5 a.m.
g train in reserved carriages. Alighting at Miller's
r, the party found a special tramcar waiting to
hem to Brighton. On the road leading to the beach,
the edge of the sand-dunes, attention was called to a
growth of the Sarsaparilla (*Muehlenbeckia adpressa*). Just
te to this a halt was called, when Professor Tate stated
hey were evidently on the edge of a low escarpment con-
of red loam, in which were to be found pebbles and
e shells, such as whelks and the valves of the mactra,
being thrown up by the action of the waves. At no dis-
period the land had increased owing to the piling action
on in the formation of the sand-dunes. The red loam
ed to projects out to the sea, and explains the existence
sh-water springs, these being the drainage from the sand-
kept in its place by the clayey soil. Mr. Luxmoore, whose
ence adjoins the road on which the party were gathered,
d them to go on to his property, where could be seen a
number of the pebbles previously referred to, their pre-
having caused some perplexity to the owner, who thought
might have been placed there by human agency. The

Digitized by Google

locality did not possess the constituents of a raised beach, and the only feasible explanation of these pebbles getting into their present position was to be found in the force of the breakers carrying them there. It was remarked in this connection that the land hereabouts was gradually encroaching on the sea, and the "gathering" action could be plainly noticed. Arriving on the beach the potash-plant (*Salsola kali*) was noticed, from which the potash of commerce was formerly obtained. This plant is generally found inland in dry saline country, and is not often seen on the seabeach. Leaving the beach for a moment, the party were taken to the foot of the sandhills to inspect a pool of fresh water. Returning to the beach the party resumed the walk. A portion of the beach was soon reached, which was stated to be a good collecting ground (after rough weather) for the conchologist, and a little further on a few scattered stones of an angular shape were noticed, the reason for their not being smooth was that they were not sufficiently numerous to rub against each other. Soon the shingle beach was arrived at, and beyond this the rocks. Having traversed this uncomfortable locality (so far as walking is concerned) for a short distance, the party halted, and the Professor directed attention to what was evidently an anticlinal axis, the strata at this part dipping in opposite directions, that to the south-east being the most plainly marked. The rocks found here, he stated, were amongst the oldest in Australia. An *al fresco* luncheon was then partaken of, after which the party walked up one of the ravines so numerous in this locality, and were afforded an opportunity of inspecting *in situ* the crystalline limestone, from which material it had been attempted to make Portland cement, but on account of its silicious nature it was unsuitable for the purpose. On the sides of this gully several interesting botanical specimens were met with, amongst which may be mentioned the grass *Pappophorum commune*, which is not often found in these parts, its favourite haunts being in the North; *Boerhaavia diffusa*, *Sida corrugata* (a desert species). Emerging from the ravine, a course was shaped in a westerly direction, and the hills forming the terminus of the foothills, Mount Lofty Range, which here trend towards the coast, were next explored. In these parts the sweet-smelling *Xerotes effusa*, the ubiquitous *Wahlenbergia gracilis*, and *Styphelia patula* were found. The carnivorous plant (*Drosera Whittakeri*) excited much attention, and a leafless shrub took some time to identify, the *savans* of the party holding different opinions on the subject. It was eventually pronounced to be *Exocarpus aphylla*, but its close resemblance to *Leptomeria* rendered identification difficult in its present state. Amongst other plants which may be recorded as found here may be mentioned *Grevillea lavan-*

Digitized by Google

dulacea, *Scleranthus pungens*, *Senecio odorata*, *Calocephalus Brownii*, *Rhagodia Billardieri*, *Alyxia buxifolia*, and the poisonous *Euphorbia Drummondi*. A few flowers of the beautiful *Hakea rugosa* were gathered. One, and one only, of the orchids was noticed, this distinction falling to *Pterostylis mutica*, and this was not in flower. Having thus enriched their botanical collections, the party returned to the rocks near which they had taken their luncheon in the morning, and shortly after 2 o'clock started on the homeward journey. They had not proceeded far when attention was called to what seemed the remains of an old beach near the top of the cliff. Prof. Tate explained that it belonged to the Older Tertiary period, and that similar beds had been seen in greater force at Hallett's Cove (three or four miles further down the coast), when the Section had paid that place a visit some time ago.

Leaving this interesting section, search was made for a well which was said to be in the vicinity. Ere long a spring was noticed, but its water was too brackish to be palatable. Next came what was perhaps the hardest piece of climbing done during the day, viz., the ascent of the high hill in front of the house formerly occupied by the late Sir George Kingston. From the summit a magnificent view was obtained.

The party, after a short rest, resumed their walk in a direct line for the tram stables, and on arrival there found a tramcar waiting, which started in time to meet the 5 o'clock train from Glenelg, the city being reached at 5.30.

Tenth Excursion—Saturday, June 13, 1885.—Botanical Gardens.

It was arranged that the Section should pay a visit to the Gardens on this date, but owing to the almost incessant downpour of rain only about half a dozen members put in an appearance. These spent the afternoon in the "Museum of Economic Botany," and were much pleased and interested with the admirable collection of botanical products which Dr. Schomburgk has arranged in this building.

Eleventh Excursion—Saturday, July 11, 1885.

This date was fixed for a visit to the Zoological Gardens, but the afternoon proved exceedingly wet; and as only a few members attended, no meeting was held.

Digitized by Google

TWELFTH EXCURSION—SATURDAY, AUGUST 15, 1886.

It was intended to make an excursion to the Grange on this date, but, as in the case of the two previous meetings, the inclement weather frustrated the plans of the Section. A few members carried out the programme, and collected on the beach a large variety of algæ, shells, sponges, sea-eggs, &c., which had been washed up by the recent rough weather.

THIRTEENTH EXCURSION—TUESDAY, SEPTEMBER 1, 1885.—HALLETT'S COVE.

Between forty and fifty members and friends proceeded to Hallett's Cove. Shortly after nine o'clock a start was made from the Town Hall, the route lying through Edwardstown and the Sturt, where a short stop was made prior to ascending Tapley's Hill. The gentlemen dismounted from the vehicles and walked up the steepest part of this gradient, noting as they went the slaty rocks and quartzites of which this hill is mainly composed. Arriving at the summit, and just after passing the ten-mile post, the road to the right was taken, which leads to O'Halloran Hill. Another turn—this time to the left—and then an almost direct course to Hallett's Cove was shaped, the destination being reached at about half-past eleven. Dismounting, the party made for Field's River, on the banks of which luncheon was partaken of. This part of the day's proceedings over, the Honorary Secretary (Mr. W. H. Selway, jun.) assembled the party, and explained the programme of the day's operation. Under the guidance of Mr. J. G. O. Tepper, F.L.S., a southerly direction was first taken, and the coast cliffs explored for flowers, which were seen in great profusion. The peculiar flora of this locality very closely resembles that of the opposite coast of Yorke's Peninsula. Approaching still nearer the coast, the members hoped to find some rocks giving evidence of glacial action, but, as these were further off than was thought, it was resolved to strike a direct course for a point some distance up Field's River, passing over a good deal of rough country on the way thither. The river was ascended for a short distance, and the stratigraphical formation of its picturesque cliffs was viewed with much interest. These were noticed to consist chiefly of masses of limestone, shales, and sandstones, very curiously crumpled, and with slaty bands occasionally interstratified. The watercourse was found to be almost covered with a species of *chara*, and among the reeds and rushes were noticed an unusually large form of *Apium prostratum* and the tall *Triglochin procera*, both in flower. One or two gentlemen who had gone to the beach returned with some very fine specimens of starfish, one especially being

Digitized by Google

of immense size and very beautifully marked. In two or three places the party found some very large boulders of granite, for the presence of which amongst the general geological features of the locality they were unable to account, except upon the hypothesis that they were glacial erratics.

After a short rest a start was made for the north side of the Cove to inspect the rocks about half a mile distant which created such interest on the previous excursion, viz., those on which the signs of ice action are to be found. The polished and striated face of the rock was shown, and those geologists of the party who had seen similar and undoubted marks of ice action in England agreed that Professor Tate, who discovered this rock, was quite justified in assigning them to the agency indicated. It was intended to search for fossils in the Tertiary beds on the way back to the coaches, but there was not sufficient time for this.

During the day the following plants (generally found only in mallee country) were collected in flower, viz.:—*Erysimum brevipes*, *Pittosporum phillyriæoides*, *Claytonia calyptrata*, *Mesembrianthemum æquilaterale*, *Enchylæna tomentosa*, *Ptilotus spathulata*, *Muehlenbeckia adpressa* (Native Sarsaparilla), *Zygophyllum fruticulosum*, var. *angustilobium*, *Stackhousia linarifolium*, *Pultenæa tenuifolia*, *Swainsonia phacoides*, *Glycine clandestina*, *Kennedya prostrata*, *Acacia spinescens*, *Tillæa macrantha* and *T. purpurescens*, *Hydrocotyle callicarpa*, *Pimelea curviflora* and *P. glauca*, *Grevillea lavandulacea*, *Hakea rugosa*, *Minuria leptophylla*, *Brachycome pachyptera* (both very pretty white starlike flowers), *B. tenella*, *Craspedia Richea* (the "Billy Button"), *Podolepis acuminata* (one of our largest-flowered composites), *Microseris Forsteri* (native yam), *Leeuenhoekia dubia*, *Velleia paradoxa*, *Bulbine bulbosa*, *Xerotes glauca*, *X. nana*, *Schœnus Brownii*, *Dampiera rosmarinifolia*, *Logania linifolia*, *Nicotiana suaveolens* (native tobacco), *Euphrasia Brownii*, and *Westringia rigida*. Of Orchids the following were gathered:—*Diuris palustris*, *D. pedunculata*, *Caladenia Patersoni*, *C. latifolia*; and three varieties of ferns, viz., *Ophioglossum vulgatum*, *Cheilanthes tenuifolia*, and *Grammitis rutæfolia*.

The party assembled at the coaches shortly before five o'clock, and after an enjoyable drive reached the city at 6.45.

FOURTEENTH EXCURSION—SATURDAY, SEPTEMBER 12, 1885.—MAGILL AND HORSNELL'S GULLY.

On Saturday, September 12, an excursion to Magill and Horsnell's Gully was made by about 20 members and friends, this being the first visit by the Section to that part of the

Digitized by Google

hills. The party left the city at 1.10 p.m. in a special tramcar, and, on arriving at Magill, started to walk up the Norton's Summit road, under the guidance of Professor Tate, F.G.S., F.L.S. They had not gone far when attention was called to a bed of conglomerates on the right-hand side of the cutting. These were resting on the upturned edges of slates, and probably indicated the recession of a former watercourse, the present channel not being far away, but at a considerably lower level. Resuming the walk the first flower gathered was soon afterwards found, viz., *Scævola microcarpa*, one specimen of which possessed additional interest on account of having a gall attached to its stem—a phenomenon somewhat rare on this plant. Attention was next called to the silver wattle (*Acacia retinodes*), which was in fruit, and on the leaves of which tree numerous galls were also seen. After walking a little farther, the road branching off to the right and leading to Horsnell's Gully was taken. Flowers here were very numerous, one of the first to attract notice being the pretty white *Logania longifolia*, while the beautiful light-yellow clusters of *Clematis microphylla* divided the honours with the first-named. *Glycine clandestina* and *Sherardia arvensis* were also collected here, and one or two flowers were already noticeable on the *Banksia marginata*. Attention was called to the poisonous *Swainsonia lessertiifolia*, which has acquired some notoriety on account of having caused the death of sheep in the South-East. The delicate white and spotted flowers of *Myoporum viscosum*, with its rich dark-green foliage, had a great many admirers. After considerable search a few specimens of *Corysanthes pruinosa* were discovered, but none in flower. Attracting notice from its brilliant yellow flowers, *Pultenæa daphnoides* was soon added to the collection. After passing a bank thickly covered with Cape Broom in bloom (*Genista canariensis*) the party arrived opposite a very fine and somewhat pyramidal-shaped bluff of rock composed of sandstones and grits, and near here in a pleasant shady spot a short rest was indulged in. A few of the party scaled the hillsides, and found three kinds of orchids, namely—*Pterostylis nana*, *Diuris maculata*, and *D. pedunculata*, there being a little doubt, however, as to whether the last of these was correctly named or not. Two other orchids gathered during the afternoon were *Pterostylis curta*, with its curious hooded appearance and green flower, and *Caladenia Patersoni*. Near the resting place was observed *Kennedya prostrata*. *Kennedya monophylla* (native lilac) was also abundant. Their energies sufficiently recruited, the party continued the walk in the same direction, amidst picturesque scenery. Soon were observed the myrtle-leaved wattle (*Acacia myrtifolia*) in bloom, and the sweet-

Digitized by Google

scented mauve-coloured flowers of *Tetratheca ericifolia*. Mr. J. G. O. Tepper, F.L.S., here directed the attention of members to a curious tuft-like proliferation found growing on a eucalypt, and said that the part of the tree above this growth subsequently dies. He stated that the cause of it was at present unknown, but that it was well worthy of investigation by scientists, pointing out that to the successful discoverer distinction was almost certain. The carnivorous sundew *(Drosera Whittakeri)* was rather plentiful. The following ferns were gathered, viz.:—*Adiantum æthiopicum* (maiden hair), *Cheilanthes tenuifolia* (the common rock fern), *Lomaria discolor*, and *L. lanceolata*, *Grammitis rutæfolia*, and *G. leptophylla*. It was now considered time to turn back, and not wishing to scale the precipitous hills by which they were surrounded, the party determined to return by the way they had come, a few members examining the creek *en route* in search of mosses, &c. Amongst other flowers, not previously mentioned, which were collected were *Cæsia vittata*, *Goodenia geniculata*, and *Stackhousia linarifolia*. The excursionists, each laden with floral treasures, returned from Magill by the 5.15 tram.

FIFTEENTH EXCURSION—SATURDAY, OCTOBER 10, 1885.—HIGHBURY.

On Saturday, October 10, about thirty ladies and gentlemen proceeded to Highbury, starting from town at 1.40 p.m., in one of Hill & Co.'s coaches. On arrival at Highbury a start was at once made under the guidance of Prof. Tate, F.G.S., F.L.S. into the scrub to the south of the road. After walking about 100 yards an excavation was reached, and this being a convenient place to point out the geological features of the locality a short stoppage was made. Having disposed of some formal business, Professor Tate addressed the members, and stated that they were on a little patch of scrub which had lost some of its characteristics by over-cropping. This scrub land was very limited in its extent, and was a remnant of a considerable sheet that extended all along the foot-hills of the main range, and was seen in stronger force at Golden Grove, to the north of which still larger patches were met with. These patches were generally recognised externally by the sanddrift that surrounded and covered them, and beneath which the rock was seen to be mostly of a soft mottled sandstone in horizontal beds, as in that particular pit near which they were standing. A few yards from this was a stone quarry showing the fundamental rocks lying at high angles, almost perpendicular in fact. This dissimilarity in inclination served to

Digitized by Google

establish the superposition of the mottled sandstones to the slates. The basal part was made up of sub-angular gravel, of which the auriferous cement rock of Humbug Scrub was an example. These, continued the Professor, were considered to be of fluviatile origin, and might be the terrestrial equivalents of the marine Miocenes seen at Government House quarry and Hallett's Cove. With the exception of a few shrubs, the large majority of the very varied plant species found in the neighbourhood were, in regard to duration, ephemeral. This seemed to be owing not so much to the quality of the soil as to its non-retentive property for water, and consequently there could only be exuberance of vegetable life when the surface was saturated. From these circumstances the greatest richness was about the margin of these Tertiary patches, and it was there chiefly that search for orchids would be directed.

The party then moved off in a southerly direction, and commenced to make their floral collections. This they experienced no difficulty in doing, as flowers were to be seen in great profusion wherever the eye turned. Although not the orchid-ground proper, yet some of these lovely flowers (chiefly the Caladenias) were gathered on this scrub land. That very beautiful dark-blue flower *Chaemascilla corymbosa* was also met with here. Ere long a sharp turn to the left was taken in order to reach the edges of the Tertiary patches, where Prof. Tate had indicated that orchids would be found. Such indeed proved to be the case, and several varieties were secured, viz., *Thelymitra aristata* (or *nuda*), *T. longifolia*, *T. McKibbinii*, *T. antennifera*, and last, but by no means least, *T. grandis*, which attains a height of three feet, with a spike of numerous flowers, which is seldom less than twelve inches in length. Of Caladenias the following were observed:—*C. Menziesii* and *C. Pattersoni*, with two or more of its sub-species. Other orchids collected comprised *Prasophyllum patens* (or *fuscum*), with its small white flowers; *Microtis porrifolia* (small green), *Glossodia major*, the flowers of which are of a purple colour.

Leaving the orchid ground, a course was struck for the aqueduct coming from the Torrens weir. On the way a discovery of an interesting little plant was made. This was *Calocephalus Drummondii*, a Western Australian species, but found in a few localities in this colony, its discovery in the latter having been made by Professor Tate at Highbury. The main road was now struck, and shortly afterwards the coach was reached.

The following are some of the plants found on this excursion, viz.:—*Dichopogon strictus*, *Brunonia australis*, with its bright blue spiky heads, *Chaemascilla corymbosa*, *Cheiranthera linearis* (dark blue), *Lotus australis*, *Pimelea humilis*, the thorny

Digitized by Google

Hakea rugosa, *Euphrasia Brownii*, and the very minute *Helipterum exiguum*, *H. pygmaeum*, and *Leeuenhoeckia dubia*. Worthy of mention is *Linum marginale* (native flax), which is remarkable in being at times affected by a gall, this being the only instance known in the world of a gall being found on a flax. One plant of the order Euphorbiaceæ was noticed, viz., *Poranthera microphylla*, which is a small poisonous species. Of the Leguminosæ may be cited *Eutaxia empetrifolia*, a small shrub literally covered with yellow flowers; *Dillwynia hispida* (dark red), and *Swainsona procumbens* (scarlet). Two varieties of *Vittadinia australis* (white and purple) were seen, which differed greatly in the form of leaf. These belong to the Compositæ, of which order *Podolepis rugata* (in bud only), *Leptorrhynchus squamatus*, *Senecio lautus* and *Microseris Fosteri* (native yam) were also gathered. Amongst a lot of other flowers more or less interesting may be mentioned *Velleia paradoxa*, *Goodenia geniculata* (both yellow), *Scævola microcarpa* (bluish white) *Cynoglossum suaveolens*, *Dianella revoluta* (blue), *Bulbine bulbosa* (yellow), *Thysanotus Patersoni* (a purple climber), *Calycothrix tetragona* (a delicate pink flower growing in very thick clusters), *Leptospermum myrsinoides*, and *Grevillea lavandulacea*. *Daucus brachiatus* (which is commonly called the native carrot, but which has no thickened root) was also found. This plant extends over the whole Australian continent. There were two Acacias, namely, *A. obliqua* and *A. myrtifolia*, the latter just out of bloom.

Shortly after 5 o'clock the coach left the Highbury Hotel, arriving in town about an hour later.

SIXTEENTH EXCURSION — SATURDAY, OCTOBER 24, 1885.— GOVERNMENT FARM.

The first of two extra excursions arranged for the month of October was held on this date, when about forty members and friends left by the 1.10 p.m. train for Belair. On arrival there a course following the railway line in a westerly direction was first taken, Professor Tate leading the way. After walking for about three-quarters of a mile a halt was called, and a short meeting held. Dr. Cleland (Chairman of the Section) presided. Two new members were elected. The meeting over, Professor Tate stated that he wished to take the geologists to a railway cutting a little further on, and invited those who took an interest in geology to accompany them. Those who were botanically inclined he recommended to search in that portion of the scrub land of Government Farm near which they were standing, and it was arranged that both parties should subsequently rejoin each other. Accordingly the party

Digitized by Google

separated, the majority favouring the study of botany. On arriving at the cutting to which reference has been made Professor Tate explained that this was a small patch of diluvial formation, consisting of sandy clays with sharp gravel underneath, and occasionally cemented by a ferruginous layer of hard rock overlying uncomformably the decomposing sandy slates. It might be regarded as a portion of the same series as they had seen at Highbury a fortnight ago. He drew the attention of the members to the contour of our hill slopes, as being such as would not result from atmospheric denudation, which tends to bring into relief the hard bands, whereas in the case of our hills the hard and soft were smoothed down to one uniform curve. The Professor then took the opportunity of making his hearers acquainted with the last phase of the controversy touching the glaciation of Australia. As bearing on the question under discussion, Mr. D. B. Adamson referred to Croll's theory as to climatic changes being due to the shifting of the earth's axis, remarking that astronomical facts did not justify this conjecture. The geologists then continued to walk along the railway line as far as a very high embankment at the entrance to a beautiful little glen. This latter, about a quarter of a mile from the embankment, is closed by lofty walls of rock, about seventy or eighty feet high in parts, a waterfall of small dimensions flowing over the extreme end. To this the party wended its way, and on arriving there the formation of waterfalls was discussed. It was pointed out that in the case of the one before them, the walls of which were composed of grit-bands, a very large mass of rock must have been washed away, and that the present flow of water was not competent to have caused this. As the erosive action progresses the waterfall itself continues to gradually lessen in height because of the inward high dip.

Mr. J. G. O. Tepper acted as guide to the botanical party, who directed their energies to that portion of Government Farm which had been recommended. The most striking feature here was the shrub *Leptospermum myrsinoides*, which was covered with its white flowers, suggestive of a fruit blossom. Attention was directed to the female pistillate flowers of the *Casuarina distyla*. This part of the hills is noted for its orchids, and several varieties were gathered. A very interesting discovery of an orchid not previously found in these parts was also made, viz., *Calochilus Robertsoni*, which is met with in the South-East, and two years ago was seen at Maclaren Vale, but previous to the date of this excursion was not known at Government Farm. A remarkable feature of this orchid is its lip, which is covered with dense hair, and presents a most peculiar appearance. Other orchids found during the afternoon were *Thelymitra*

Digitized by Google

longifolia, *T. antennifera*, *Microtis porrifolia*, *Prasophyllum patens*, *Pterostylis barbata*, *Caladenia Menziesi*, *C. dilitata*, and *Glossodia major*, three distinct colours of the last-named being noticed, including a pure white one. Two or three kinds of Droseras were seen, and their insect food pointed out. Those very minute flowers *Stylidium despectum* and *S. calcaratum* were gathered. The latter of these, in some points, is not unlike the *Polypompholyx tenella*, which is supposed to be carnivorous, and contains a sweet secretion which is thought to lure insects to their destruction. *Isopogon ceratophyllus*, *Helichrysum scorpioides* and *H. Baxteri* were collected. Growing near a watercourse were the small pink *Lythrum hyssopifolia* and the native flax (*Linum marginale*). The pink *Erythræa australis*, which in the summer months is seen in abundance in many parts of the colony, was already in flower, and is noted for its tonic properties. A little way up the glen was seen a rich bank of maidenhair fern (*Adiantum æthiopicum*), and in a short time the waterfall was reached, where the other party were enjoying a rest, and in which they were now joined by the botanical section. On discussing results Professor Tate reported that he had found a very rare plant, viz., *Euphrasia scabra*, which is an annual, and very local, this being the first time the Professor had met with it. Near the waterfall the rarer plants noticed were *Verbena officinalis*, *Siegesbeckia orientalis*, *Cynoglossum suaveolens*, and *C. australis*. When their energies had been sufficiently recruited the whole party started on the homeward journey, following much the same course as that by which the botanical division had come. Returning to the pasture-land, *Brachycome diversifolia*, *Ajuga australis*, and *Pultenea pedunculata* wers collected, while the banks were gay with the white Stichwort (*Stellaria glauca*). One or two members, who had not gone as far as the others, had found *Veronica Derwentia*, which had not been met with by the rest of the party. On the way back the sedge (*Schœnus Tepperi*), discovered by Mr. Tepper on Yorke's Peninsula, was noticed. Amongst other flowers not previously mentioned which were gathered may be noted *Dillwynia hispida*, *Tetratheca ericifolia*, *Euphrasia Brownii*, *Lavatera plebeia*, *Brunonia australis*, *Cheiranthera linearis*, *Scævola microcarpa*, and *Burchardia umbellata*.

The party reached the Belair Station in time to leave by the 5.36 train, having spent a very enjoyable afternoon.

SEVENTEENTH EXCURSION—SATURDAY, OCTOBER 31, 1885.—STONYFELL.

This day, like several of the previous dates fixed for excursions, proved exceedingly wet; but notwithstanding this 20

Digitized by Google

members and friends proceeded to Stonyfell, leaving by the 2 p.m. car for Burnside. Just after reaching the Burnside-road, and opposite the house of Mr. J. Stuart Sanders, the car stopped, and guided by Mr. J. G. O. Tepper, the party turned into an open section on the eastern side of the road, and started on their walk in the direction of the hills. They had not proceeded far when a spring was noticed, around which were growing various forms of vegetation. Whilst examining this Mr. J. S. Sanders, who had espied the party from his house adjoining the section in which they were walking, came up and invited them to go into his grounds. He mentioned that the spring near which they were standing was running all the year round. Professor Tate explained that this was due to its gravel bed resting on a subsoil of clay which retained the water, the clay being coterminous with the edge of the spring. Around the spring were found the following plants:—*Stylidium despectum*, *Cyperus tenellus*, *Tillæa macrantha*, *Juncus cæspititius*, and *Scirpus riparius*. Mr. Sanders then showed the party over his extensive and well-kept garden. A portion of Mr. Sanders's property is still kept in its natural state, and several indigenous flowers were gathered there, amongst others *Helipterum dimorpholepis*, *Grevillea lavandulacea*, *Hibbertia densiflora*, *Velleia paradoxa*, *Dianella revoluta*, *Linum marginale* (native flax), and *Calycothrix tetragona*. The shrub *Bursaria spinosa*, was also noticed, but its usual characteristic, the spines, was absent. Before leaving the grounds of Mr. Sanders a short meeting was held, and a new member elected. A hearty vote of thanks was passed to Mr. Sanders for his kindness to the Section. The party then continued the walk up the slope, where the following were collected, viz., *Styphelia humifusa* (the cranberry), *Isoetopsis graminifolia*, *Calocephalus Drummondi*, *Podolepis Siemssenia*, and *Ptilotus erubescens*. A somewhat rare plant found here was *Goodenia amplexans*, which also grows at Hallett's Cove and one or two places in the Mount Lofty Range. After crossing the road at the back of Mr. Newland's house, that tertiary patch of country was reached to which Mr. Tepper recently referred in a paper read before the Section. The drift material seems to extend higher up the slopes here than at any other part along the range. This particular place is perhaps the nearest to town, and the most accessible site for obtaining similar plants to those growing on the higher elevations of the Mount Lofty Range. Some of those, also, that are met with here are not found on any other part of the range. When ascending this hill a shower of rain detained the party for some time, during which they took shelter behind some small gums (*Eucalyptus leucoxylon*). This gave an opportunity for calling attention to the *Eriogasta*,

Digitized by Google

one of the *Coccidæ*, which attacks these trees, and was seen in thick clusters on the branches. This parasite is a favourite article of diet with ants, which extract nourishment from a small hole in the shell which surrounds it. The ants, however, do not kill the *Eriogasta*, and the tree eventually dies. The rain over, the walk was resumed, and soon Stonyfell was reached, on the right of which is a quarry and on the left Mr. Crompton's vineyard. A road has been made as far as the quarry, beyond which the hill is exceedingly wild and rugged, and progress very difficult. The most noticeable botanical feature about here on Saturday was *Prostanthera Behriana*, the beautiful flowers of which excited great admiration. After careful search *Anthocercis angustifolia* was found, a plant which is restricted to only a few localities in South Australia and is found nowhere else in the world. Other plants collected at Stonyfell were *Dodonæa viscosa*, *Grevillea lavandulacea*, *Pimelea humilis*, *Pultenæa acerosa*, *Acacia continua*, *Senecio hypoleucus*, and *Ixodia achilleoides*, the last-named being the small white flower which is used for making funeral wreaths. After a short rest amidst the picturesque scenery at the head of the gully, the party walked back to Kensington, returning thence by tramcar to the city, which was reached about 6.30.

———o———

EVENING MEETINGS.

First Evening Meeting—Tuesday, May 19, 1885.

On this evening Mr. J. G. O. Tepper, F.L.S., was to have read a paper on "Local Orchids," but owing to the small attendance the reading was postponed till June 23.

Mr. Somerville brought for exhibition a specimen of a resinous substance which exudes from a species of grass-tree found in New South Wales (*Xanthorrhœa hastilis*), and which it was thought might become a useful article of commerce. It was mentioned that a shipment of it had been sold in London for six shillings and seven shillings per hundredweight, and that a somewhat similar exudation had been noticed by Prof. Tate, F.G.S., F.L.S., on Kangaroo Island.

Second Evening Meeting—Tuesday, June 16, 1885.

There was a good attendance; Professor Tate, occupied the chair. Four new members were elected. Mr. W. E. Pickels (the Secretary), who was one of the founders of the Section, tendered his resignation on the ground that his frequent ab-

Digitized by Google

sence from town interfered with his duties. His resignation was accepted with regret, and a motion to that effect was carried. The resignation of Mr. G. F. Hussey as a member of the Committee was accepted in similar terms, and Messrs. W. J. Sowden and G. G. Mayo were elected to fill the vacancies in the Committee. Mr. W. H. Selway, jun., was elected Hon. Secretary.

The Chairman brought under the notice of the Section a periodical started by Mr. Joseph Wing in Victoria, and called the *Southern Science Record*, which he strongly recommended.

The Chairman stated that no representative of *Cordiceps* or *Torrubia* (vegetable caterpillar) is recorded for South Australia, but in digging at Nairne he found what he believed to be a *Cordiceps* parasitic on the larva of a beetle, and this he exhibited.

Mr. Tepper said he believed a *Torrubia* of a large size, some four inches long, occurred near Alice Springs.

The Chairman also showed some specimens submitted to him by a gentleman in Tasmania, who believed them to be slugs. They have a general resemblance to the liver-fluke, but there are two little tentacles springing from the upper surface. He could not claim them as slugs, but thought they might turn out to be land *Planaria*.

Mr. G. Beazley, the Museum taxidermist and articulator, then gave some practical illustrations in the art of preparing birds for stuffing.

THIRD EVENING MEETING—TUESDAY, JUNE 23, 1885.

Mr. G. Collis presided. There was a small attendance. Mr. Grasby exhibited about forty-four varieties of mosses and lichens from the banks of the River Onkaparinga at Oakbank. They were collected by the local school children in the course of an outdoor excursion under the guidance of Mr. Grasby.

Mr. Tepper exhibited a lampglass with marks upon it, giving it the appearance of being cracked, when in reality it was perfectly sound. The seeming flaws were in his opinion formed either by minute fungi or the action of saline matter from the dampness of the straw in which the glass was packed. Mr. Tepper then gave his lecture on "Local Orchids," and, with the assistance of diagrams, explained the peculiar nature and beauties of the plants, pointing out the structure of the flowers, which in all their multifarious variety exhibited the same general ground plan. He said there were thousands of species distributed over almost the whole land surface of the earth. In Australia 255 species in forty-six genera were recorded by Sir F. von Mueller, of which seventeen, with fifty-three species,

Digitized by Google

were noted from this colony, but probably more existed. Some forty-nine species and varieties have been collected by Mr. Tepper in the neighbourhood of Adelaide, chiefly about Clarendon. A short discussion ensued, and Mr. Tepper mentioned the localities where different varieties of orchids could be found, such as Stonyfell, Clarendon, Kensington, and Government Farm, and he said sandy deep ground was favourable to the flower.

FOURTH EVENING MEETING—TUESDAY, JULY 14, 1885.

Professor Tate occupied the chair. There was a moderate attendance. One new member was elected. Dr. Magarey exhibited some shells. Professor Tate gave the names as *Obeliscus brunnea*, a rather rare shell, from Glenelg; *Anatina gracilis* and *Marcia faba*, from the mouth of the Onkaparinga; and *Columbella bidentata* and *Mitra Tatei*, from Salt Creek; the first had not yet been catalogued as a South Australian shell. Mr. J. G. O. Tepper showed an interesting collection of South Australian seaweeds. Professor Tate showed fossil teeth of *Ceratodus*, found in the central lake region of Australia, associated with remains of the *Macropus atlas*; a toe and bones of an emu-like bird, crocodilian remains, and part of the bony carapace of the turtle. It seemed highly probable that the fish belonged to the same species as that living in Queensland, *C. Fosteri*. In 1872 Mr. Krefft found the teeth of the *Ceratodus* in the conglomerate in the basin of the Condamine River, in North Queensland, which he considered to be of an extinct species, and last year Mr. De Vis, curator of the Brisbane Museum, found specimens in another locality, and considers that they are not different from the living species. Professor Tate thought from these evidences that his speculations on the existence of a large fresh-water area in Central Australia were proved to be correct.

Mr. W. Howchin, F.G.S., then read a paper on "Storms and Weather Charts." The lecturer dealt with the construction and uses of the barometer, with special reference to its application to meteorological science. The laws regulating storm phenomena were explained by means of the blackboard, and large diagrams were used to illustrate the hydrography and principal storm tracks as observed in Australia. The isobaric lines and signs used in the delineation of weather charts were interpreted, and some useful observations were given bearing upon Australian climatology. The storms which occur over the southern half of Australia, the lecturer remarked, almost invariably pass from west to east, first making themselves felt in Western Australia, skirting the coast with their centres well off the

Digitized by Google

land, and pass over Tasmania and New Zealand. The gathering area of these storms is probably the southern portions of the Indian Ocean, following the lines of atmospheric currents and condensation of vapour, they impinge on the south-western limb of the continent, where they are turned southwards by the anti-cyclonic conditions which normally prevail on the land. Hugging the shore they pass eastwards, and usually gather intensity as they approach the eastern limits of the continent, probably reinforced by aqueous currents flowing southwards along the eastern coastline. This intensifies the barometrical depression, whilst the area of the storm widens out, heavy gales are experienced in Bass Strait and over the adjacent coasts, spending their greatest force upon Tasmania and New Zealand. A few of our storms come up from the Southern Ocean, or have a retrograde motion from the east westwards, but these are very exceptional instances. The average rate at which storms travel may be given as about sixteen miles an hour, or 400 miles in the twenty-four hours. But this is a very uncertain feature. A storm centre may hang over a given region for several days together, or it may move forward, slowly or rapidly, without any apparent cause for such irregularity of movement. It generally takes from two days to a week for a storm to pass from the Leuwin to Adelaide, and about twenty-four hours more to reach Melbourne. The diameter of storms is seldom under 600 miles from lip to lip of the depression, but they are often vastly larger, taking in the whole of Europe, or stretching from Australia to New Zealand in one vast turmoil of wind and rain. They die a natural death by the filling up of the barometrical depression, but this sometimes does not take place until they have travelled more than half round the world. A short discussion ensued, in which the lecturer was asked to explain some points, and amongst them how it was that the readings of the barometer in South Australia did not show such extremes as in Great Britain for example. The reply was that the majority of storms which visited us had their centres well to the southward of the continent, so that Adelaide was brought only under the influence of the northern lip of the depression, where the readings of the barometer were not so depressed as nearer the storm centre.

FIFTH EVENING MEETING—TUESDAY, JULY 28, 1885.

On this evening Mr. G. Beazley gave a second "Demonstration in Taxidermy." There was a fair attendance. Mr. Beazley read a paper dealing with the bony frame of birds, and explained how lightness and strength were combined in its con-

Digitized by Google

struction. The entire anatomy of the bird was described in detail, and articulated skeletons of various birds were shown in illustration of the subject. Mr. Beazley then proceeded to give a practical demonstration of the method of preparing and stuffing birds, also deer, lizard, and leopard, skins of which he exhibited. He showed a beautiful specimen of the large fish *Cossyphus Gouldii*, or blue groper, and explained the method of preparing it. A hearty vote of thanks was accorded the lecturer at the close of the meeting.

SIXTH EVENING MEETING—TUESDAY, AUGUST 18, 1885.

There was a moderate attendance. Professor Tate occupied the chair and directed attention to an exhibit of a mass of fossil oyster shells from the River Murray cliffs, and said the particular species was found in beds of three, four, and even twenty or thirty feet thick. It differed in certain particulars from the Port Lincoln oyster. He gave it the name of *O. Sturtiana*, in honour of Captain Sturt, who first recorded its occurrence at Overland Corner. The Professor also directed attention to a specimen of *Solen vaginoides*. It seemed almost confined to the north shores of Kangaroo Island, but had been found in the Port Creek, though not alive,

Professor Tate then read the following paper on

MOLLUSCAN LIFE IN ST. VINCENT GULF.

A. SURFACE LIFE.—The only species at all common is the squid *(Sepioteuthis Mauritiana)*; another cephalopod has occurred, it is *Spirula lævis*. The violet-tinted shells of *Ianthina exigua* and *I. violacea* have been taken; but on the open coastline the *Ianthinæ* and another species, *I. communis*, the delicate *Argonauta*, and a few *Pteropods* are sometimes cast up in great numbers. The majority are swimmers; the *Ianthinæ* are sustained by floats.

B. BOTTOM LIFE.—The action of the waves below the surface decreases as the depth increases, ceasing at a few fathoms. Below this surface-disturbance no movement occurs except that caused by the quiet flow of ocean currents. The molluscs exposed to the action of the waves exhibit a rich variety of adaptation of structure to the various conditions under which they live. These variations are chiefly in respect of the powers of attachment or locomotion, according as to whether the habitat is unstable or not under the attacks of waves and currents. The mollusca, in respect to habitat, or the kind of bottom on which they reside, may be considered under the following heads:—(1) Those which live between tide-marks in bays and

Digitized by Google

estuaries sheltered from wave disturbances; (2) those which live on the seashore exposed to wave and tidal action; (3) those living at the sea-bottom outside the tidal strand. The species are not only restricted in their range in depth, but also in respect to habitat in accordance with their structure.

Littoral Life.—1. Mollusca living between tide-marks in sheltered bays and estuaries.—Exemplar stations are the Port Creek and the estuary of the Onkaparinga. The tidal strand is here usually composed of mud often clothed with a green mantle of Zostera; whilst pools at the upper limit of the tide furnish a vegetable growth of *Lepilæna Preissii*, amongst which live *Pomatiopsis striatula*, *Tatea rufilabris*, *Bithynella Victoriæ*; whilst at the extreme upper limits of ordinary tides, sheltering under *Salicornia*, *Suæda*, *&c.*, the pulmonates *Ampullarina Quoyana*, *A. fragilis*, *Alexia meridionalis* and *Pythina ciliata*; and *Risella melanostoma*, *Assiminea sp.* Between tidal-marks the majority of the gastropods are vegetable feeders—*Bittium granarium*, *B. Lawleyanum*, *B. turritum*, *Risella melanostoma*, *Trochochocolea tæniata*, *Acmæa conoidea*. The only common carnivorous gastropod is *Tropon australis*. Here is the chief habitat of the bivalves *Tellina deltoidalis*, *Anapa cuneata*, *Chione aphrodina* and *Modiola flavida*—the three former burrowing by means of their foot, the last forming a nest for itself in the soft mud.

2. Mollusca living on the tidal strand of the exposed coast. —These may be considered under two heads, viz., *(a)* Those living on rock or other firm foundation, and *(b)* those living in sand or mud.

(a) Those living on rocks. The methods by which they resist the attacks of waves are various, some of which are well known. Examples of permanent attachment are the oyster and mussel, of temporary attachment, the limpet and chiton, and of boring, the pholas. In addition, there is a large number deficient in powers of attachment, which find protection from the waves by secreting themselves under large flat stones or in rocky crevices. Living on rock, as it were between air and water, and where moistened only by the spray of the breakers, occur the pulmonate snails *Marinula patula* and *Truncatella scalarina*, and the branchiferous snail *Littorina Mauritiana*; whilst the minute bivalve *Lasea rubra* nestles in crannies of the rock-face. The gastropods living on rocks exposed to breakers have almost without exception shells of an ovate or rounded outline, shortly conical or more or less flattened—shapes best adapted to resist the action of the waves. A list of the commoner species was given. The carnivorous species are few, the commonest ones are—*Trophon Flindersi*, *Pupura succincta*, *Ricinula Adelaidensis*, *Cominella costata*, and *C. alveolata*. All

Digitized by Google

of these have considerable powers of attachment by the aid of their broad locomotive discs; their shells are excessively thick, and though not so rounded in outline as the majority of the littoral snails, yet they are not strictly elongate. An aberrant snail (*Cladopoda arenaria*) inhabits an irregularly convolute tube agglutinated by the lower half to rock surfaces. The bivalves are very few in number, and the only commonly occurring ones are *Mytilus rostratus*, *M. Menkeanus*, *Modiola australis*, which are anchored in patches or clusters by their byssal threads; amidst the mussels the little *Lasæa rubra* finds a safe dwelling. The rock oyster (*O. glomerata*) is occasionally found here, out of its usual station below low-tide mark. On flat rocky shores, as off Snapper Point, Aldinga Bay, and about Stansbury and other places on the west side of the Gulf, the cavernous depressions of the surface, and the shelter afforded by the large flattened stones, are the lurking places of many gastropods, whose shape of shell and formation of foot ill adapt them to live in exposed situations.

(*b*) Those living in sand. This habitat is unstable under the attacks of the waves, and no powers of attachment will serve the animal; safety lies in the quickness with which it can penetrate the sand either to avoid being washed away in the denudation of the deposit, or to force its way to the surface through any accumulation that may he piled over it. The only gastropod which habitually lives in this habitat is *Natica conica*, whose shell is smooth and subconic, not well adapted for burrowing, but offers a passive resistance to wave currents. On the ocean seaboard, where tidal disturbances are so much greater, there lives anothes species (*N. Inceï*), which has a hemispheric shell. The bivalves, which inhabit this kind of deposit, have compressed valves and hatchet-like or cylindrical forms well suited for rapid penetration; whereas the globular form of shell, which is ill-adapted to force its way through a resisting medium, is unrepresented on our sandy tidal region. One of the most active in penetrating sand in which it lives is *Solen vaginoides*, having a narrow cylindrical form. All the bivalves live in long burrows, and have long siphons, which must be valuable in self-defence, more especiallv in the case of their young, which, from their small size, would be affected by much slighter wave disturbances than the adults, and would be in constant danger if obliged to live at the surface or close to the surface of the deposit that gave them shelter.

The little *Mesodesma elongata* resides at little depth below the surface, and nearer high-water mark than any other of the burrowing species, and is therefore particularly liable to be exposed, as is fully attested by the vast numbers displaced during gales. It burrows, however, very readily, and moves on

Digitized by Google

the surface of the sand with much expedition. Our two species of Pholads (*Barnea similis* and *B. australasiæ*) and *Venerupis obesa* burrow in stiff clay at low-water mark.

Molluscs living beyond low-tide.—Those living on rocky bottoms present no special feature from those living between tide-marks, except that a greater number of species occur, increasing somewhat with the depth. The greatest variety of life occurs undoubtedly on rocky bottoms extending to a few fathoms in depth. Here haunt a large species of *Octopus*—*Cypræa thersites*, the *Volutes*, *Ostrea Angasi*, *Pecten laticostatus*. The delicate parchment-like shell of *Avicula pulchella* anchors to the stems of seaweeds, and the delicate limpet, *Nacella parva*, creeps upon them; *Waldheimia australis* also in the same position, and fixed to other submarine bodies. *Gastrochæna Tasmanica* lives in crypts which it excavates in limestone or in the thick test of oysters.

Molluscs living on soft bottom beyond tidemarks.—In shallow water ranging to six fathoms life is very abundant, especially among the submarine pastures of *Cymodocea zosterifolia* and *Posidonia australis*, which afford secure protection against ordinary wave currents, and are the favourite haunts of the Sepias and Sepiolas among cuttlefish. Globose bivalves and slender turrited shells here only are found. It is unnecessary to enumerate the species inhabiting this region, but I may indicate some of the novelties in respect to habit. *Pinna Zealandica* lives in large colonies anchored vertically in the mud by means of its sharp apex and long byssal threads; parasitic on it are *Crepidula immersa*, *Amalthea conica*, *Placunanomia Ione*, *Hipponyx*. The delicate *Anatinas* form deep burrows; *Vulsella ovata*, *Modiolaria Cumingiana*, *Siliquaria australis*, and *S. Tahitiensis* burrow in sponges; whilst *Pecten asperrimus* is conversely the host of a soft red sponge: a species of *Eulima* lives on *Cidaris* and other echinoderms.

The waters of St. Vincent Gulf are for the most part very shallow, and little or no exploration has been carried beyond a few fathoms, except in one instance only, to my knowledge, in Backstairs Passage, whence was obtained a few mollusca, from 32 fathoms, which have not been met with elsewhere in the Gulf, and some not at all. They are *Erato lachryma*; *Cardita sp.*; *Gastrochana lamellosa*; *Limea*, *n sp.*; *Terebratulina cancellata*.

In adding a few remarks on the subject of his paper, the Professor pointed out that if the Port Creek and Largs Bay were each to be fossilized, it would be found that the common shells of the one were not the same as the common shells of the other. He did not agree with the attempts that had been made to place the various fossil localities in the Older Tertiaries

Digitized by Google

of South Australia in superposition. Dissimilarity of life did not always indicate difference of age. Some cases of fine specimens were exhibited and examined.

Mr. A. Molineux then read an interesting paper on "Methods of Exploring the Sea Bottom," in which he described various appliances used in trawling and dredging, and referred to an element of danger in the pursuit, viz., stings from various fish that are armed with poisonous barbs and spines, *e.g.*, catfish, perch, gurnet, and particularly the "cobbler" (*Apistes marmoratus*), stated that he had tried grappling-irons for the deeper waters of the passage between Cape Jervis and Kangaroo Island without encouraging success, and concluded by pointing out that when dredging and trawling are conducted for scientific purposes a great many particulars were recorded, viz., latitude and longitude; depth, temperature, and density of water; direction and force of wind; the tides; the number, species, varieties, character, &c., of specimens obtained; the time of year, and many other things.

After an expression of opinion on the desirability of further dredging operations in the Gulf the meeting closed.

SEVENTH EVENING MEETING—TUESDAY, SEPTEMBER 15, 1885.

Professor Tate occupied the chair. There was a good attendance. One new member was elected. A number of specimens obtained on the trawling expedition of the previous evening, consisting of sponges, crustaceans, fishes, ascidianes, molluscs, and other denizens of the Gulf, were exhibited, and the President made explanatory remarks. A specimen of a rare snake—the *Hoplocephalus spectabilis* of Krefft—found at Scott's Creek, near Nairne, was exhibited by Professor Tate. The reptile was alive, and of a poisonous species, but Professor Tate stated that it was very small, and practically harmless. It was very little known. A specimen was obtained some twenty years ago in the Port Lincoln district by Mr. Masters, and he (the speaker) had found one since at Ardrossan. Mr. J. G. O. Tepper, F.L.S., showed some orchids from Kangaroo Island, comprising *Caladenia lolifolia*, *C. clavigera*, *C. filamentosa*, *Diuris longifolia*, *Liperanthus nigricanes*, *Prasophyllum* (sp. large-flowered), *Caladenia* (with very small flowers, perhaps new), and *Pterostylis* sp. The President announced that owing to the continued illness of Dr. Stirling, his lecture, "The Borderland of the Animal and Vegetable Kingdoms," was postponed. Mr. Molineux described in a conversational way some of the marine curiosities secured at a trawling expedition on the previous evening. A so-called native hare

Digitized by Google

(*Peragalea lagotis*), with a young one in the pouch, was shown by Mr. Beazley; it came from Orroroo.

ANNUAL MEETING—TUESDAY, OCTOBER 13, 1885.

There was a fair attendance. Four new members were elected. Along one side of the room was arranged a fine collection of New Zealand ferns by Mr. J. G. O. Tepper, F.L.S. There were exhibited on the table a number of specimens obtained on trawling expeditions, and they were briefly noticed by Prof. Tate, who named a cuttlefish as *Sepia brevimanus*, so called from the short arms. The largest size he had met with was thirteen inches. A great novelty presented was the young of the Echidna. The Professor also described a tray of interesting shells; also some orchids (submitted by Mr. Tepper) which were not of any recorded species.

Professor Tate said the work of the past year had not been of such an encouraging kind as could have been desired. They had had a good deal of lecturing during the winter evenings, but the Society had not progressed. That might arise from the novelty wearing off, but those that remained were the ardent students. In comparing the work done by this Section with that done by a similar Society in Melbourne, he might say that the field excursions here were better attended than those of the Melbourne Field Club, but on the other hand the night-work over there was far in advance of ours. There was always a long list of exhibits drawn from all parts of the world, and generally an indication of better work by the students. The excursions here had been comparatively well attended, but the evening meetings poorly so. Perhaps the members had lost sight of the real object of the evening meetings, which was to supplement the knowledge gained at the excursions. Although he ceased to be Chairman he would ever be ready to show as active an interest in the Society as heretofore. The Secretary then read the following:—

ANNUAL REPORT OF THE COMMITTEE.

"In submitting the second annual report of the Section the Committee are pleased to be able to regard the year's proceedings as on the whole of a satisfactory and encouraging nature.

"The novelty attaching to the inauguration of the Section (it being an entirely new feature for the colony) has now had time to wear off, and, although the large gatherings at the first few meetings have not since been equalled, the attendances this year, especially at the whole-day excursions, have been well sustained.

Digitized by Google

"Five whole-day and ten half-day excursions were arranged for during the year, a new departure having been instituted in fixing outdoor meetings in the winter as well as summer months. Owing to the unfavourable state of the weather, however, on the days fixed for Saturday afternoon excursions in the months of May, June, July, and August those meetings virtually fell through, proposed visits to the Botanical and Zoological Gardens being amongst the number.

"Seven evening meetings have been held most of which were fairly attended. On two of these occasions demonstrations in taxidermy were given by Mr. G. Beazley with the kind permission of the Museum authorities.

"In the month of May, 1885, the Committee received with great regret the resignation of the Honorary Secretary of the Section, Mr. W. E. Pickels, F.R.M.S., on account of his removal to another colony. The Committee desire to express their sense of the loss sustained by the Section in consequence of this step, and their appreciation of the energy and ability with which Mr. Pickels conducted its affairs.

"A by-law has been passed by the Section requiring Fellows of the Royal Society to pay a registration fee of one shilling each if desirous of becoming members of the Section. This action has been confirmed by the Royal Society.

"Thirty members have been added to the Section during the year, but about fifty names have been removed from the roll, either on account of resignations, non-payment of subscriptions, or for other reasons. The present number of members is therefore less than at the close of last year. It is evident that very many of those whose names appeared on the roll have taken but little interest in the active work of the Section, not a few having never attended any of its meetings, and others but very seldom.

"During the year the Council of the Royal Society conferred on the Section the honour of inviting the members of the latter to be present at the meetings of the Royal Society.

"The expenses of the Section have been, as in the previous year, much greater than the receipts from subscriptions, the latter amounting to about £20, while the disbursements (chiefly for printing and postage), have been about £40. It is intended, however, to adopt a system in the coming year by which it is hoped the Section will become self-supporting.

"For the Committee,

"W. H. Selway, Jun., Hon. Sec."

Professor Tate, in reference to the report, said the expense were about double the amount of the receipts. He hoped to see a balance on the right side next year, so that there might be a surplus to set apart for awarding prizes. He would

Digitized by Google

supplement the sum to a reasonable amount. He moved the adoption of the report, which was carried.

The election of officers then took place, as follows:—Chairman, Dr. Cleland; Vice-Chairmen, Mr. J. G. O. Tepper and Dr. Magarey; Hon. Secretary, Mr. W. H. Selway, jun.; Committee, Professor Tate, Messrs. Molineux, G. G. Mayo, G. Collis, H. Dean, D. J. Adcock, D. Fleming, W. J. Sowden.

After some scientific discussion and a paper read by Mr. Tepper upon the "Geological Features of Stonyfell"—

Professor Tate stated that a testimonial had been purchased by the members of the Society for the late Secretary, Mr. Pickels.

The testimonial, a handsome gold chain and locket, the latter suitably inscribed, was handed over to Mr. G. Collis, who responded for Mr. Pickels, and undertook to forward it to that gentleman.

OFFICERS.

CHAIRMAN:

Mr. W. L. Cleland, M.B.

VICE-CHAIRMEN:

Mr. J. G. O. Tepper, F.L.S.
Mr. S. J. Magarey, M.B.

COMMITTEE:

Professor Tate, F.L.S., F.G.S.
Mr. A. Molineux.
Mr. G. Collis, jun.
Mr. H. Dean.
Mr. D. J. Adcock.
Mr. G. G. Mayo.
Mr. W. J. Sowden.
Mr. D. Fleming.

HON. SECRETARY:

Mr. W. H. Selway, jun.

Digitized by Google

FIELD NATURALISTS' SECTION OF THE ROYAL SOCIETY OF SOUTH AUSTRALIA.

BALANCE-SHEET, 1st OCTOBER, 1885.

1884.	Dr.	£	s.	d.
Oct. 22.	Balance in hand	5	12	0
1885.				
May 17.	Grant from Royal Society of South Australia..	20	0	0
Sept. 24.	" " " ..	35	0	0
		£60	12	0

1884.	Cr.	£	s.	d.
Nov. 2.	Secretary, W. E. P., Cash	1	0	0
Dec. 1.	" " "	1	0	0
Jan. 10.	" " "	1	0	0
Jan. 24.	" " "	0	10	0
Feb. 18.	" " "	1	0	0
Mar. 10.	" " Postages	8	0	0
Mar. 15.	" " Cash	1	10	0
Mar. 19.	Sherring & Co., Printing	15	1	6
June 30.	Geo. Beazley, Expenses	1	8	9
Sept. 24.	Sherring & Co., Printing	22	16	0
Sept. 30.	Handed to Treasurer Royal Society ..	7	5	9
		£60	12	0

W. H. SELWAY, Jun., Hon. Sec.

Audited and found correct,

WALTER RUTT,
LIONEL C. E. GEE } Auditors.

Adelaide, 30th September 1885.

LIST OF MEMBERS

OF

FIELD NATURALISTS' SECTION

OF THE

ROYAL SOCIETY OF SOUTH AUSTRALIA

AT DATE OF ANNUAL MEETING, OCTOBER 13, 1885.

Those marked † are Fellows of the Royal Society, S.A.
Those before which the letter F appears are foundation members.

†FAdamson, Mr. D. B., Angas-street, Adelaide.
FAdcock, Mr. D. J., Currie-street, Adelaide.
Addison, Mr. H. M., King William-street, Adelaide.
FAitken, Mr. J., Parkside.
Anderson, Mr. T. G., N.E.-road, Medindie.
FBaker, Mr. W. H., 34, King-William-street.
Beazley, Mr. Geo., The Museum, Adelaide.
†Beresford, Mr. D. J. D., Parliament House, Adelaide.
Best, Mr. D. (Hon. Memb.), 16, Little Collins-street E., Melbourne.
Bevilaqua, Mr. L. W., Fullarton.
FBeythein, Mr. E., Moonta.
FBishop, Mr. J. F., Union Bank, Adelaide.
FBottomley, Mr. W. D., Savings Bank, Adelaide.
FBoulger, Professor, University, Adelaide.
Bowen, Mr. F. C., Freeman-street, Adelaide.
Brook, Mr. W. J., J.P., Pirie-street, Adelaide.
Bruce, Mr. J., Architect-in-Chief's Office, Adelaide.
†FBruer, Mr. J. J., King William-street, Adelaide.
†Bussell, Mr. J. W., F.R.M.S., Railway Station, Adelaide.
Chipp, Mr. H. E., Currie-street, Adelaide.
†FCleland, Dr. W. L., Parkside.
Cleland, Mrs. W. L., Parkside.
FCollis, Mr. G., jun., Gawler-place, Adelaide.
Coppen, Mr. E., c/o Mrs. Symes, Grenfell-street, Adelaide.
Cornock, Mr. T., The Museum, Adelaide.
FDane, Mr. F. N., Eliza-street, Waymouth-street, Adelaide.
†FDavies, Mr. E., Flinders-street, Adelaide.
FDean, Mr. H., jun., Carrington-street, Adelaide.
Dixon, Mr. S., c/o Messrs. Luxmoore & Co., Limited, Adelaide.
†FDobbie, Mr. A. W., Gawler-place, Adelaide.
Dombrain, Mr. H. A. A., c/o Messrs. Young & Smith, Waymouth-street, Adelaide.
†FEvans, Mr. T., King William-street, Adelaide.
FFabian, Mr. T., City Treasurer, Adelaide.
FFarrar, Mr. G. E., C.E., Clare.
FFleming, Mr. D., Mackinnon-parade, North Adelaide.
†FFletcher, Rev. W. R., M.A., North terrace, Kent Town.
Fornachon, Mr. C. L. F., Y.M.C.A., Adelaide.

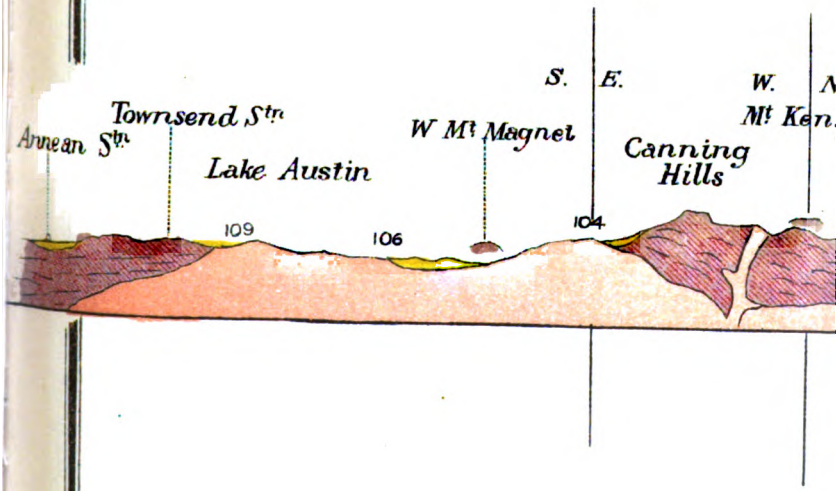
Digitized by Google

rFrayne, Mr. N., c/o Messrs, D. & W. Murray, Adelaide.
rFrench, Rev. S., M.A., Glenelg.
rFuller, Mr. W., University, Adelaide.
†Gall, Mr. D., Tynte-street, North Adelaide.
Gallagher, Mr. W. E., Port Germein.
Gee, Mr. L. C. E., c/o Surveyor-General's Department, Adelaide.
Grasby, Mr. W. C., Salisbury.
Guest, Mr. E. (Hon. Memb.), Balhannah.
Gurner, Mr. J. R., North-terrace, Adelaide.
Hammond, Mr. H., Childers-street, North Adelaide.
rHampson, H., Leigh-street, Adelaide.
rHaslam, Mr, J., C.E., Pirie-street, Adelaide.
Hill, Mr. C., Alix House, South-terrace, Adelaide.
Hill, Mr. W. H., Quorn.
†rHowchin, Mr. W., F.G.S., Goodwood E.
Howell, Mr. F. J., H.M. Gaol, Adelaide.
Howell, Mr. Geo., Pirie-street, Adelaide.
rHunwick, Mr. Charles, Hindmarsh.
rHussey, Mr. G. F., G.P.O., Adelaide.
Jacobs, Mr. Geo. W., Currie-street, Adelaide.
Jameson, Mr. Geo. E., Union Bank, Adelaide.
Jobson, Mr. C., Hydraulic Engineer's Office, Adelaide.
Johnson, Mr. J. A., Franklin-street, Adelaide.
Johnson, Miss, "St. Catherine's," Prospect.
†Kelly, Rev. R., Mount Barker.
Kirby, Mr. E., Farina.
†Knight, Mr. G. C., Durstan House, North Adelaide.
Lawrance, Mr. V., J.P., Lefevre-terrace, North Adelaide.
Lawrance, Mr. C., Lefevre-terrace, North Adelaide.
Lawson, Mr. J. D., Divett-place, Adelaide.
rLeader, Mr. C. S., King William-street, Adelaide.
†Leary, Mr. J. L., M.A., South-terrace W., Adelaide.
Light, Mr. W., Wentworth, N.S.W.
Lindow, Mr., Messrs. J. S. Sanders & Co., Hindley-street, Adelaide.
rLock, Mr. E. H., *Register* Office, Adelaide.
†rMagarey, Dr. S. J., North-terrace, Adelaide.
Magarey, Mr. T. C., jun., Waymouth-street, Adelaide.
†rMayo, Mr. G. G., Pirie-street, Adelaide.
rMcEwin, Rev. J., *Colonist* Office, Currie-street, Adelaide.
†rMestayer, Mr. R. L., C.E., F.R.M.S., Hydraulic Engineer, Adelaide.
rMillar, Mr. A. P., Adelaide.
†rMohan, Mr. J. H., Crafers.
†rMolineux, Mr. A., Kent Town.
rMolineux, Mr. A. E., Kent Town.
†rMunton, Mr. H. St., North-terrace, Adelaide.
O'Connor, Mr. M. J., Public Library, Adelaide.
†Parker, Mr. T., C.E., St. Vincent's Chambers, Port Adelaide.
Phillips, Professor, M.A., University, Adelaide.
†rPickels, Mr. W. E., F.R.M.S., Melbourne.
Poole, Mr. W. B., Savings Bank, Adelaide.
†rPoulton, Dr. B., Adelaide Hospital, Adelaide.
Pullein, Mr. R. H., King William-street, Kent Town.
Read, Mr. Geo. A. G., Telegraph Office, Adelaide.
Robertson, Mr. J., Angas-street, Adelaide.
Robertson, Mr. W., North-terrace, Adelaide.
rRogers, Mr. A. L., 3, Rundle-street, Adelaide.
Rosenhain, Mr. O. W., Box 125, G.P.O., Adelaide.
rSansom, Mr. P., Currie-street, Adelaide.

Digitized by Google

rSelway, Mr. W. H., jun., The Treasury, Adelaide.
rShapter, Mr. W. T., Public School, Gumeracha.
†Smeaton, Mr. S., B.A., Bridgeport.
†Smyth, Mr. J. T., B.A., B.Sc., Model School, Norwood.
rSowden, Mr. W. J., *Register* Office, Adelaide.
†rStirling, Dr. E. C., M.A., Lefevre-terrace, North Adelaide.
†rTate, Professor, F.G.S., F.L.S., Buxton-street, North Adelaide.
rTate, Miss, Buxton-street, North Adelaide.
Taylor, Mr. G., South-terrace, Adelaide.
†rTepper, Mr. J. G. O., F.L.S., Somerset-place, Norwood.
Thwaites, Mr. F. J., National Bank, Adelaide.
†Todd, Mr. C., C.M.G., Postmaster-General, Adelaide.
†Varley, Mr. A. K., Kirtonville, Mount Gambier.
†Wainwright, Mr. E. H., Collegiate School of St. Peter, Hackney.
Walker, Mr. A., Y.M.C.A., Adelaide.
Watts, Mr. H. (Hon. Memb.), Wellington-street, Collingwood, Melbourne.
Webb, Mr. W. H., William-street, Norwood.
rWhatham, Mr. F. G., Freeman-street, Adelaide.
rWhitney, Mr. F. M., Messrs. J. Colton & Co., Adelaide.
†rWhittell, Dr. H. T., F.R.M.S., Astor House, New Glenelg.
Wilson, Mr. I., F.E.I.S., Goodwood.
Wilson, Mr. S. P., Uraidla.
Wiseman, Mr. A., Freeman-street, Adelaide.
Witherick, Mr. J., Waymouth-street, Adelaide.
†Woodward, Mr. H. P., F.G.S., Government Geologist's Office, Adelaide.
†Wragge, Mr. C., F.R.G.S., The Observatory, Torrens Bank, Walkerville.

Digitized by Google



VARDON & PRITCHARD, GRESHAM-ST., ADELAIDE, LITHO.

Digitized by Google

Digitized by Google

Digitized by Google

Digitized by Google

Digitized by Google

Digitized by Google

TRANSACTIONS AND PROCEEDINGS

AND

REPORT

OF THE

ROYAL SOCIETY of SOUTH AUSTRALIA.

VOL. IX.

(For 1885-6.)

ISSUED MARCH, 1887.

Adelaide:
G. ROBERTSON, 103, KING WILLIAM STREET.
1887.

rcels for transmission to the Royal Society of South Aus-lia, from Europe and America, should be addressed "per C. Rigby, care Messrs. Thos. Meadows & Co., 35, Milk Street, Cheapside, London."

Digitized by Google

Webb, Vardon, & Pritchard, Printers, Gresham Street, Adelaide.

Royal Society of South Australia.

Patron:
HER MAJESTY THE QUEEN.

Vice-Patron:
HIS EXCELLENCY SIR WILLIAM ROBINSON, K.C.M.G., C.B., &c.

OFFICERS.

[Elected October 5, 1886.]

President:
PROFESSOR RENNIE, D.Sc., F.C.S.

Vice-Presidents:
WALTER HOWCHIN, Esq., F.G.S. (Editor).
RICHARD L. MESTAYER, Esq., C.E.

Hon. Treasurer:
WALTER RUTT, Esq., C.E.

Hon. Secretary:
W. L. CLELAND, Esq., M.B.

Other Members of Council:
H. T. WHITTELL, Esq., M.D. (Re-presentative Governor)
C. TODD, Esq., C.M.G., M.A.
D. B. ADAMSON, Esq.
J. W. BUSSELL, Esq.
PROFESSOR BRAGG, B.A.
J. DAVIES THOMAS, Esq., M.D.

Assistant Secretary:
MR. A. MOLINEUX.

Digitized by Google

CONTENTS.

PAGE.

W. Ernest Cooke: A Few Notes on Jupiter (plate i.) 1

Prof. E. H. Rennie: Poisoning by Tinned Foods 10

J. G. O. Tepper: Notes on Some South Australian *Trogidæ* and a New Species of *Trox* 12

J. G. O. Tepper: Notes on *Ogyris Amaryllis*, Newm. 13

G. Goyder, Jun.: On the Production and Measurement of Gold and other Metallic Spheres to determine their Weight 15

R. B. Lucas: On the British Standards (plates vii.-xiii.) 18

Gavin Scoular: Sketch of the Geology of the Southern and Western Parts of the Lake Eyre Basin (plate iii.) 39

Baron F. von Mueller: Additions to the Extra-Tropical Flora of South Australia 57

Baron F. von Mueller: Description of a New Corchorus from Central Australia 58

Prof. R. Tate: Diagnosis of a New Species of Caladenia (plate ii.) .. 60

Prof. R. Tate: Description of some New Species of South Australian Marine and Fresh Water Mollusca (plates iv.-v.) 62

Prof. R. Tate: A Revision of the Recent Lamellibranch and Palliobranch Mollusca of South Australia 76

J. G. O. Tepper: Description of a Supposed New Species of Phasmidæ (plate vi.) 112

J. G. O. Tepper: Additions to the Flora of Kangaroo Island 114

John Brazier: Troghidæ and other Genera of South Australia, with their Synonyms, Part I. 116

E. Gurst: A Classified List of Geometrina found round Balhannah, with Notes on Species 126

Prof. R. Tate: The Lamellibranchs of the Older Tertiary of Australia, Part II. (plates xiv.-xx.) 142

Prof. R. Tate: The Scaphopods of the Older Tertiary of Australia (plate xx.) 190

Prof. R. Tate: The Pteropods of the Older Tertiary of Australia (plate xx.) 194

Clement L. Wragge: Scientific Observations made during the Voyage of the Maranoa from London to Adelaide, 1883 (plates xxi.-xxvi.).. 201

Digitized by Google

MISCELLANEA.

Plants Collected in the vicinity of the Mulligan River by Mr. W. H. Cornish—Baron F. von Mueller 213

Additional Lichens and Fungi of South Australia—J. G. O. Tepper .. 215

Excerpts from Baron von Mueller's Third and Fourth "Supplements" 216

Additions to the Entomological Fauna of South Australia—E. Meyrick. 218

New Australian Freshwater Entomostraca 219

Remarks on an Unusual Development of a Low Vegetable Organism—W. Howchin 219

Abstract of Proceedings 221

Annual Report 225

President's Address 228

Balance-sheet 247

Donations to the Library 248

List of Fellows, Members, &c. 254

APPENDIX.

PROCEEDINGS OF FIELD NATURALISTS' SECTION—

EXCURSIONS—Rocky Gully—Montacute—Waterfall Gully—Onkaparinga—Mount Lofty—Aldgate—Glen Stuart—Fletcher's Dock—Trawling in St. Vincent Gulf—Marino to Hallett's Cove—Patawalonga Creek—Glen Stuart—Government Farm—Golden Grove—Blackhill—Highbury and the Gerge 257-280

EVENING MEETINGS—

Gossip Meetings 280-283

Lectures—Chairman's (Dr. Cleland) Address; J. G. O. Tepper, "Metamorphosis of Insects;" Walter Howchin, "The Preparation of Microzoa;" Dr. Stirling, "The Borderland of the Animal and Vegetable Kingdoms; W. T. Bednall, "Bivalve Shells" 283-290

Annual Meeting and President's (Dr. Cleland) Address .. 291

List of Members 298

MICROSCOPICAL SECTION 301

Digitized by Google

A Few Notes on Jupiter.

By W. Ernest Cooke, B.A., Assistant Astronomer.

[Read February 2, 1886.]

Plate I.

The phenomena revealed in the Jovian system are as remarkable as they are obscure, and evidently denote the existence of forces in an intensity of manifestation utterly unknown in this world at the present time. The condition of Jupiter's surface is a subject for interesting speculation. We cannot possibly say with certainty what that condition may be, but have reasons for believing that some of the whiter portions, at all events, consist of a semi-transparent vaporous substance. Mr. Todd, our Government Astronomer, was the first to point out this peculiar semi-transparent property; for on one occasion, when watching an occultation disappearance, he distinctly saw the satellite *through* the planet's limb, and could still see it when its light must have pierced through more than a thousand miles of the surface matter of the planet. This was confirmed by subsequent observation and after the fact had been pointed out several other astronomers, including Mr. Ellery, of Melbourne, observed the same effect. I have witnessed this phenomenon on several occasions during the past two or three years, when the definition of the limb has been so remarkably sharp as to utterly preclude any idea of optical illusion. The whole of the planet's surface, however, is not white, but there are well-marked dark belts, which seem to keep their shape more or less the same for a number of years, and dark and bright spots that disappear and reappear in a remarkable manner, some apparently suddenly, but most, I think, gradually. The principal belts (all of which are almost parallel to the equator) are two dark ones about five to ten degrees on either side of the equator, and inclosing a broad equatorial light band, with many interesting markings. Besides these there are occasionally visible narrow belts in the northern and southern temperate and polar regions. The two principal ones seem to have kept their position ever since systematic observations have been taken, but they are noticed to be constantly changing in points of detail. The light equatorial band seems to be the centre of the most intense forces, for the markings here are constantly changing. I think it would be difficult in any series of sketches to find the same detail twice on this part of the planet. The *general* appearance remains fairly steady for some

Digitized by Google

length of time. During almost all of its last apparition the general appearance was that of a series of beautiful festoons, sometimes depending from the northern dark belt, but usually throwing out pillars to the southern and more conspicuous of the two. The interior of these festoons was generally beautifully white by contrast with the darker matter forming their substance, and sometimes, under not very favourable atmospheric conditions, would appear like brilliant white spots. I think it is quite possible that this has given rise to a degree of confusion with some astronomers in the northern hemisphere in respect to this part of Jupiter's surface, which will be referred to presently. Underneath a remarkable hollow in the south dark belt is the most striking feature on the whole planet —the great red spot. Spot is hardly an appropriate name for a space in which the whole of Australia would be lost, but it is the name that happens to be attached thereto. It is just possible that this spot was observed by Cassini in 1665; at all events, a famous spot was observed in that year by this illustrious astronomer. The next notice of it is in 1792, when Schroeter was observing an occultation of the planet by the moon on April 7. The most remarkable phenomena noticed were two nebulous undefined spots, perceptibly darker than the principal belt; and a still more remarkable spot is represented by Schroeter in the southern hemisphere of the planet, circular, bright in the centre, and with a dusky shading all round. A similar spot was also observed in 1786 and 1787. In 1868 Mr. Denning records on the south belt a dark spot of elliptical form. This may have been the precursor of the great southern ellipse first observed by Mr. Gledhill on November 14, 1869. This ellipse was situated in about the same latitude as the great red spot at present is, and is very likely the same object. In fact, a sketch made on January 23, 1870, reveals a most striking similarity to the present appearance of the planet in almost every respect. The first certain record we have of the appearance of the great red spot is from some observations made at the Morrison Observatory by Professor C. W. Pritchett in July, 1878. He says:—"On July 9 Jupiter was again examined from 11h. to 12h. 5m., Gl. M. T. I was surprised at the extraordinary changes which had occurred both in the spots themselves and in the contiguous parts of the belts. Two spots still showed, but much enlarged, and with irregular outlines. Their position, however, was very different from the position noted on July 6. The place of one was a little west of the most easterly one seen on July 6, and near the inner edge of the northern equatorial belt; but the other had changed to the south side of the southern equatorial belt, and far eastward, and seemed to be rapidly breaking up. What was more remarkable

Digitized by Google

was a total change of the whole structure of the belts in that vicinity and the formation of an elliptic cloud-like mass, separate from the general contour of the belts. This cloud was almost a perfect oval in shape, and was pre-eminently rose-tinted. But the most remarkable phase of all was the *rapid proper motion* of this 'elliptical cloud.' I watched it for nearly an hour, and in that time its front moved on the disc of the planet about one-fourth of the planet's diameter. It passed by the most easterly of the spots, and its front had reached to the most westerly spot, and was passing it at 12h. 5m., Gl.M.T." These remarks of Professor Pritchett were not written until November, 1878, and meanwhile other observers had noticed this spot. Mr. F. C. Dennett first saw it on July 27, and makes the following remarks *re* its proper motion:—"Between July 27, 13, and November 11, 5.5, the longitude of its preceding extremity seems to have increased some 24°, which means a proper motion eastward of more than 230 miles per day. But that is not all. At 6h. 5m., October 25, the oval patch was well elevated in the south temperate zone, whilst on November 11, 5.5, it had seemingly 'pushed' the equatorial belt some 8,000 miles nearer the equator." The next that seems to have been heard about this spot was from a letter written to the "Observatory" of April 1, 1879, by Mr. E. Leopold Trouvelot, of Cambridge, U.S.A., dated January 20, 1879. He observed it for the first time on September 25, 1878, at 6.30, C.M.T., and in his letter draws attention to the fact that it is apparently periodic in its visibility. He thinks, however, that this may not have been the identical spot seen on July 9 by Professor Pritchett, although it occupied almost exactly the same position; for Professor Pritchett failed to see it on July 10 and 15, when it should have been visible if it existed; and Mr. Trouvelot also failed to see the spot on September 6, 10, 15, 20, and 22, when Jupiter presented the same region to the observer. (We must not forget, though, that Mr. Dennett observed the spot on July 27.) Mr. Trouvelot further says:—"Between September 19 and 20 considerable changes occurred in the markings of the planet, the southern border of the equatorial belt assuming at one point a very characteristic angular form, which on the 25th was recognised on the west of the red spot, and quite close to it. If the red spot had existed on the 20th it is impossible that it should have escaped notice, as the atmospheric condition was very fine on that night, and a good drawing of Jupiter was obtained. It seems certain, therefore, that this spot formed between the 22nd and 25th of September, as it was not seen on the 22nd at 7h., C.M.T. It is very remarkable that this spot appeared precisely at the same place, or, at least, very nearly so, where a similar

Digitized by Google

object had been observed over two months before. The recurrence of some of the markings on Jupiter at the same places where similar forms had already been observed previously, although quite a rare phenomenon, is not, however, without precedent, as appears from my observations of this planet. For instance, the angular marking on the southern border of the equatorial belt described above, and near which the red spot made its appearance, very strikingly illustrates the principle of recurrences, since this spot, so familiar to me, has disappeared and reappeared three times in a period of observation embracing a little over one year." There seems to be something curious about this remark, for this particular marking is now visible, and has been ever since the appearance of the red spot. It is true that the angularity is now on the eastern side of the red spot, but this is attributable to a very gradual change, occurring as described below, and is due neither to a motion westwards of the red spot, nor to a sudden alteration of the belt. A similar angularity was noticed on the eastern side of the spot shortly after Mr. Trouvelot made his remarks, and it looked then as if the great red spot was simply an oval patch of the southern dark belt that had got separated and moved southwards, a huge bight being formed in the belt immediately north of the spot, of which the two angular formations previously noticed formed the edges. After a time a white streak was noticed almost all along the middle of the southern dark belt, and this gradually spread over that portion of the belt immediately west of the spot, until now the dark belt at this part of the planet is reduced almost to two streaks, the northern (corresponding to the north edge of the remainder of the belt) being very dark, and the southern so faint as to be almost invisible unless the definition is good.

Then, with regard to the periods of visibility of the red spot. In August, 1879, Professor Pritchett, in referring to Mr. Trouvelot's remarks, gives several dates on which the red spot ought to have been seen if it were visible, but mentions that, although he looked carefully for it, he was unable to see a sign of it. These dates are 1878, July 10, August 15, 31, September 10, 20, 22, October 2, and November 2. Added to these we have the days when Mr. Trouvelot looked for and failed to see it, viz., September 6, 10, 15, 20, 22. But, on the other hand, Mr. Dennett observed it on July 27, and at the Adelaide Observatory it was first noticed on August 4, and was again seen on the 9th and 13th of the same month. Professor Pritchett goes on to say:—"I find by numerous trials that this spot is plainly visible in my telescope with a power of 275 for more than two hours before and after passing the middle point of its visible arc of rotation. Here, then, are at least eight

Digitized by Google

different occasions on which I have observed Jupiter *closely* when this spot *should have been seen*. In several of them it should have been near the *middle of the disc*. Even considering its longitude 240 deg. (as Mr. Dennett has done), it could not *possibly* have passed out of sight by axial rotation. I cannot think it could be *present* and escape my attention, unless its character had *wholly changed;* for anyone who sees it *now* and *as it was* on July 9, 1878, a year ago, will at once detect it on any part of the disc. For instance, on the morning of July 2, 1879, as soon as my eye glanced on the disc I recognised it, though seen very *obliquely* to the line of sight and seen *unexpectedly* after the lapse of a year. Now, whether this spot has periods of 'recurrence,' as Mr. Trouvelot suggests, or whether at certain times it has a very rapid proper motion on the surface of the planet I cannot pretend to determine. On July 9 of last year I saw it extend beyond a white spot north of it, but *which was in motion* is unknown. . . . It is important, I think, to remember that both *preceding* and following the observation of July 9 the belt region was in a state of unusual agitation." I think that, taking into consideration Mr. Dennett's observation of July 27 and our own on August 4, 9, and 13, we may safely assert that the red spot was *visible* from July 9 (the first record we have of its appearance), until August 13. Then the question naturally arises, "Did this spot suddenly disappear between August 13 and 15, on which latter date Professor Pritchett failed to see it, although it should have been plainly visible?" If so, it is a most extraordinary occurrence, especially considering its enormous size. Then, as to the other hypothesis, "Could it have had an enormous proper motion at that time?" Of course it must be borne in mind that at present it is impossible to ascribe a proper motion to any spot on Jupiter, for astronomers have not yet satisfactorily settled which particular spots belong to the planet itself, and which are moving on its surface, and hence are unable to fix a period of revolution. But still it may be interesting here just to compare two notes, one by Professor Pritchett, already quoted, where he remarks on the motion of the red spot past two white spots in its vicinity, and the other made by Mr. Todd on the night of August 13, 10h.:—"The oval red space on the southern bright belt, noted on the 4th, still visible, but not the bright spot on the equatorial cloud belt, but a bright spot very like it precedes it several Jovian hours—being near the western edge of the planet, when the red space was rather more than half visible on the opposite or eastern side of the planet."

At present the red spot looks very similar to what it did in 1878 and 1879, although not quite so dark. Its immediate surroundings, however, have altered to a certain extent. If

Digitized by Google

we were to compare the drawing of Jupiter made on July 9, 1878, by Professor Pritchett with one made by ourselves at the present time, it would be difficult to imagine that it was one and the same object. But I cannot help thinking that the drawing published in the *Observatory* scarcely does justice to the subject. The drawing shows scarcely any sign of Jupiter's two well-known dark belts on either side of the equator, although Professor Pritchett makes constant reference to them. However, from our own remarks made about July, 1878, it is evident that there has been no enormous change in Jupiter's physical appearance. The most noteworthy alterations in the immediate neighbourhood of the red spot have been, first, the formation of that angularity in the southern dark belt immediately west of the spot, then the formation of an indentation in the south edge of the belt, and lastly, the evident superposition of that white cloud streak along the portion of the belt west of the spot, which has gradually widened until the belt is now reduced to a mere streak. In 1883 and 1884, however, the red spot became very faint indeed, and when the definition was unsteady could not be seen at all, even when at mid-transit. During periods of good definition we could just faintly glimpse it, but on most occasions we could only see its northern edge, which merged into a faint coloured streak a little south of the dark belt. The Director of the Dearborn Observatory (Mr. G. W. Hough) seems to have observed this spot all through 1883 and 1884. In his annual report for 1884 he says:—"It was seen on various occasions, with the Chicago telescope, entirely separate and distinct from any belt, and presenting the same outline that it did in 1879. The most marked change has been in its visibility. During the latter portion of the previous opposition it became very faint, and was announced to have disappeared, but observations were made on it at the Dearborn Observatory as long as the planet was visible."

The period of Jupiter's rotation has for a long time been, and is now, a *quæstio vexata* among astronomers. As early as Cassini's time the period was fixed at 9h. 55m. 30s., and ever since then various observers have deduced periods ranging from 9h. 55m. to 9h. 56m. Most of these have been obtained from well-defined *dark* markings, situated on or to the polar side of the two principal dark belts.

In 1871, however, Dr. Lohse took some observations of a bright spot near Jupiter's equator, and found the period of rotation of this spot to be less than 9h. 52m. In the "Ephemeris for the Physical Observations of Jupiter," Mr. Marth has until quite recently adopted 9h. 55m. 4s.; but in the Supplement to the monthly notices of the "R.A.S.," vol.

Digitized by Google

44, he has changed his period to 9h. 50m. 20s., this being the rate of rotation of a certain white spot in the equatorial regions. This seems to be a great mistake, for if it has always been the same white spot observed, it is far more reasonable to suppose that this spot has an enormous proper motion (something like 2,000 miles per day) westward, than to imagine that this spot has remained in the same place while all the other markings have been moving simultaneously eastward at this pace. The Director of the Dearborn Observatory seems to have devoted a considerable amount of attention to the rotation period of the red spot, and he obtains a mean for 1883-4 of 9h. 55m. 38·5s., or a mean for five years (1879-84) of 9h. 55m. 37·01s. There is one great disadvantage in taking "white spots," viz., that on the equatorial belt there are such a number of them, often coming and going on the same evening with the variability of definition. But the red spot cannot be mistaken, and it has always kept its position immediately south of the great hollow in the southern dark belt. Last year there were three beautiful little dark spots on the south edge of the southern dark belt, and these kept their positions relative to the red spot approximately ever since they were first observed here on February 19, 1885. They were situated a little east of the red spot, and could all be seen on the planet at the same time. The most eastern was just like the shadow of one of the satellites, quite black and round; the centre one not nearly so dark as either of the others, and elongated; the most westerly was of an elongated oval shape, and of a very dark red colour. No very accurate measures were taken, but a sufficient number of sketches were made to give a tolerably exact period of revolution, and the central spot gives for 77 revolutions 9h. 56m. 7s. In a similar manner the red spot from 70 revolutions gives 9h. 55m. 34s. On March 18, 1885, we discovered a round dusky spot on the equatorial light belt, just below the northern dark belt; this passed the central meridian at 11.41 a.m. It was observed on several occasions since, and again, after twelve Jovian days, passed the central meridian on March 23 at 9.47 a.m. This gives a rotation period of 9h. 50m. 30s., almost identical with that adopted by Mr. Marth in his "Ephemeris." I think there can be no doubt, however, that this is not a fair rotation period to assume, for by far the majority of the markings rotate in periods varying from 9h. 55m. to 9h. 56m., keeping their positions relative to one another at all events approximately. It is certainly curious that the white spot of Mr. Marth and our own little dusky spot should give so nearly equal a result, but from an inspection of our sketches it is easily seen that the dusky spot has a large proper motion westward relative to its environment.

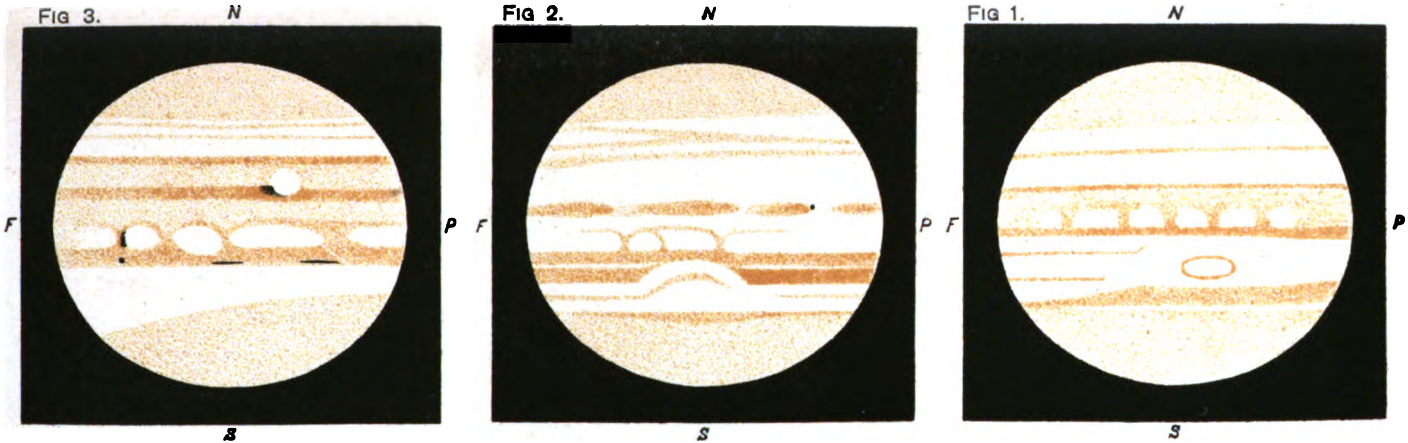
Digitized by Google

There is, for instance, a well-defined break or hollow in the northern dark belt, which at first preceded the spot by some 20m., but which, on the 23rd, was considerably to the east of the spot. It is a noticeable fact that both the white spots and this dusky spot are on the light equatorial belt, and there are also one or two fainter markings on this belt that seem to keep their position relative to the dusky spot. It thus appears that the surface on the equatorial bright belt moves round faster, at the rate of about 2,000 miles per Jovian day, than the portions connected with the darker belts to the north and south of the equator. This extremely interesting hypothesis has been often previously stated.

It will be well in conclusion to take a rapid glance at the general physical appearance of Jupiter's surface at the present time. All round the north pole, extending to about latitude 45°, is a dark grey shading, which seems to defy the resolving power of even the largest and best telescopes. At times, with an unusually good definition, it presents a streaky appearance, and seems to consist of innumerable very fine lines parallel to the equator. South of the shading to about latitude 10° to 15° N. the planet's surface is of a white or very faint yellowish colour, broken by two dark bands encircling the planet in about latitude 23° and 25°. At 10° or 15° N. is the northern edge of the north dark belt. This is by far the most irregular belt or band on the planet. It is roughly parallel to the equator—as, in fact, are all the belts—but on either edge are protuberances, hollows, knots, breaks, &c., while the interior is constantly exhibiting white patches or streaks, looking like masses of white cloud. The northern edge is usually well defined, but the southern gradually merges into the equatorial bright belt. This belt is, perhaps, the most beautiful portion of the planet. Its general appearance, without critical examination, is that of a light reddish band round the centre of the planet, darker on the north than on the south side, and with a number of white-looking patches, somewhat like a bank of cumulus cloud resting on the dark belt bounding its southern extremity. On more careful examination it will be noticed that there are a series of festoons, some regular, but for the most part of a somewhat irregular formation, the tops of the arches making a wavy line along the equator; while the pillars of the festoons extend downwards to the south dark belt, which very often forms a protuberance to meet them. It is very likely, I think, that the white patches inside of these festoons, which are constantly changing, have given rise to the irregular rotation periods that have been quite recently deduced for Jupiter's equatorial regions; and the most interesting questions for the present Jovian season will centre in the

Digitized by Google

Digitized by Google



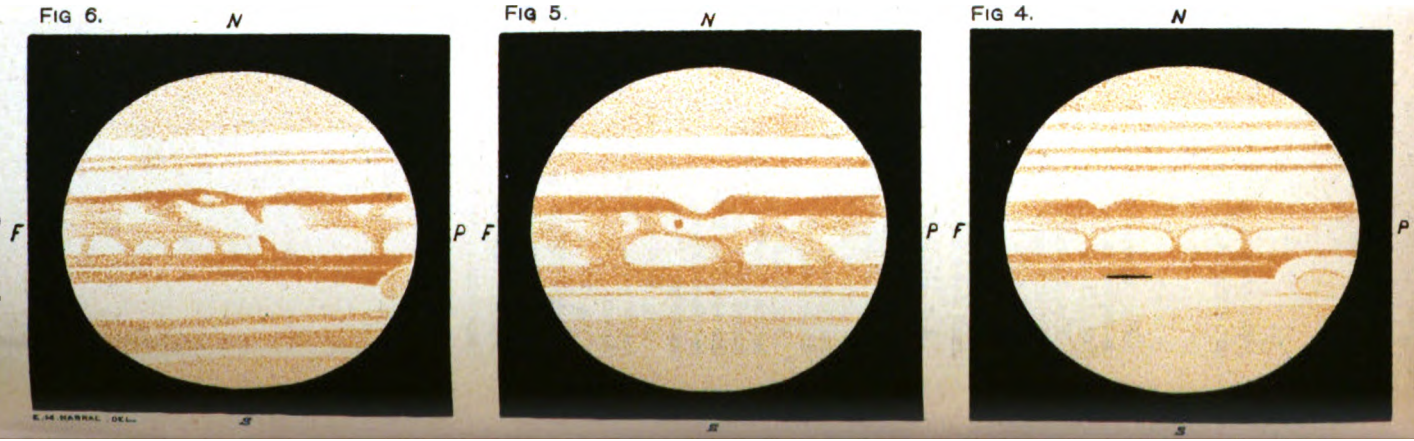


PLATE I.

Digitized by Google

permanence of any particularly white spot or patch, and its movement, if any, relative to the great red spot.

Explanation of Plate I.

Fig. I. represents Jupiter's surface on 1870, Jan. 23, 8.20 G.M.T. This is copied from a sketch made by Mr. Joseph Gledhill, and published in Vol. III. of "The Observatory."

Fig. II. represents Jupiter's surface on 1884, April 21, 5.51 A.M.T. The definition was excellent. The portion of the broad dark belt west of the great hollow was of a deep reddish colour. The curved shading just below the hollow was all that could be seen of the Great Red Spot. The northern dark belt was considerably split up, and at one place, near the preceding limb was a dusky black spot. Power used 200.

Fig. III. represents Jupiter's surface on 1885, Feb. 19, 9.45 A.M.T. The definition was excellent. The most striking features were three dark markings on the southern edge of the broad dark belt. The most western was elongated, and the most eastern quite round, like the shadow of a satellite; the central marking was not so distinct as either of the others though near mid-transit. Two other dark markings were noticeable, one on the northern side of each of the principal belts. Power used 200.

Fig. IV. represents Jupiter's surface on 1885, Feb. 21, 10.16 A.M.T. The definition was not very good, except at times. The Red Spot was just going round the preceding limb, but was plainly visible. The dark marking on the south dark belt is the same as the preceding one of the three in the previous sketch. Equatorial light band seemed to consist of a series of festoons. Power used 200.

Fig. V. represents Jupiter's surface on 1885, March 18, 11.17 A.M.T. Definition fair. Most noticeable feature, dusky spot on the equatorial belt, as shown. Power used 200.

Fig. VI. represents Jupiter's surface on 1886, Jan. 22, 13.20 A.M.T. Definition very good. The Great Red Spot is just going off. The most noticeable feature is the manner in which the south dark belt becomes suddenly fainter to the east of mid-transit. Power used 200.

Note.—All sketches, except the first, were taken with an 8 inch refractor; focal length, 9ft. 11in.

Digitized by Google

Poisoning by Tinned Foods.

By E. H. Rennie, M.A., D.Sc., Professor of Chemistry in the University of Adelaide.

[Read April 6, 1886.]

In December, 1885, a family at Tanunda, S.A., who had partaken of some tinned fish (Machonochie's fresh herrings) were seized with violent symptoms indicative of an irritant poison. The portion of the fish which remained uneaten was forwarded to me by the President of the Central Board of Health for examination. Analysis revealed the presence of considerable quantities of tin—about 0·25 grain oxide of tin to a tablespoonful of fish—and traces of lead, the interior of the tin being much corroded. Under an impression, which seems to be a general one, that tin salts are poisonous, I gave the opinion that in the case referred to the symptoms were due to the presence of these compounds in the fish.

A very similar case occurred about the same time at Murrurundi, N.S.W., the symptoms having been caused by eating tinned fish of the same brand; but Dr. Ashburton Thompson (Medical Inspector under the Board of Health, Sydney) informed me that in this case there were some symptoms which could not be referred to an irritant metallic poison alone, and he at the same time expressed himself as more inclined to believe that all these cases were referable to animal poisoning. He at the same time pointed out that were they due to poisoning by tin compounds illness of the same kind would probably be much more frequent, the presence of tin in larger or smaller quantities having been so frequently recognised.

Since then my attention has been called to a paper published in a German periodical devoted to physiology (reference unfortunately lost), and to an abstract (*Lancet*, 1886, p. 455) of a paper by Dr. Patenko. In the former paper an account is given of experiments with two soluble tin compounds, viz., tin triethyl and the double tartrate of tin and sodium, on various animals, and it is shown that while the subcutaneous injection of these compounds gives rise to very serious symptoms, the administration of large doses by the mouth day after day produces little or no effect. In the latter paper an account is given of similar experiments with "bichloride of tin," with similar results.

These facts, coupled with recent investigations on the for-

Digitized by Google

mation of poisonous cadaveric alkaloids, or *ptomaines*, in putrifying animal and vegetable matter, lend considerable probability to the animal poison theory. In connection with this it may be mentioned that a member of the firm above referred to has stated—whether on sufficient grounds or not I cannot say—that all these cases of poisoning have occurred in the summer time, and when the fish has been eaten after the tins have remained open for some time.

It must be borne in mind, on the other hand, that the fish could not have been in such a state of putrefaction as has been usually considered necessary for the formation of ptomaines, otherwise it would have been quite unpalatable; and, moreover, I have been informed of cases of poisoning after partaking of tinned fruits—*e.g.*, pineapples (in which much tin was found), and in which, much sugar being present, it is difficult to understand how putrefaction could have advanced to such an extent as to produce the effects observed, without rendering the fruit quite uneatable.

There is still another suggestion as to the cause of these symptoms, viz., the presence of *living* poisonous matter, which has found in the foods referred to a suitable medium in which to grow and multiply. And here I may quote a case, an account of which was communicated to me quite recently by Mr. Hamlet, Assistant Government Analyst in Sydney, N.S.W. Some persons who had partaken of a tin of black currant jam were seized with symptoms of poisoning. A chemical examination failed to detect any metallic or other poison, but a microscopic investigation revealed the presence of considerable quantities of *fungi* of various kinds.

Obviously the matter needs investigation, but such an inquiry is beset with many difficulties. It is scarcely necessary to point out that if we are to arrive at any satisfactory conclusion in the matter, and to find a means of prevention, careful records of all cases should be kept, even of minutest details.

Digitized by Google

Notes on some South Australian Trogidæ, and a New Species of Trox.

By Mr. J. G. O. Tepper, F.L.S.

[Read July 6, 1886.]

The *Trogidæ* are a family of *Coleoptera* widely distributed, but are not attractive either for colour or habits. They are usually of a dull black, brownish, or grey, live on dry dung, skin, hoofs, or under putrid dead animals, but do not trouble man. In form they are oval, the back arched semi-cylindrically, and the elytra not only cover the whole body, but extend, in many species, in a fairly wide margin under the flat abdomen. In this case they are usually joined in the middle, the wings being absent. Whenever disturbed these beetles simulate death by drawing the legs tightly under the body, the head in a cavity under the prothorax, and the short antennæ (with three lamellæ) into a depression of the tibia of the front legs. No amount of torturing seems capable of startling them into motion. Central Australia, to the west coast, appears to produce the largest of the genus *Trox*, viz., *Trox* (*Phoberus*, McLeay) *gigas*, Har. (the species was kindly identified by the Hon. W. McLeay), of which two specimens are in the Museum, marked "Port Wakefield" and "Ardrossan" respectively. It is nearly an inch in length, and half as wide, dull black, with three rows of twelve or thirteen shining black conical tubercles on each elytron, generally arranged two, three, seven, or two, four, six, the four near the posterior extremity being much more prominent than the others, especially the medial two.

More than a year ago a gentleman from the neighbourhood of Eucla left some fifteen or sixteen specimens of similar beetles at the Museum, stating that they were obtained in the arid country one hundred miles north of that place. They are known there under the name of "Musk Beetles," as they emit a most powerful musk-like odour, which even now is still very strong. Some specimens were sent to the Hon. W. McLeay, in Sydney, who pronounced them as a new species. It differs from *Trox gigas*, though of the same size, or even larger, by a different serration of the tibiæ of the forelegs; the claws smaller and less spreading, and the form, position, and number of tubercles upon the elytra. Each of the latter bears fifteen to seventeen low oblong tubercles, nearly alike in height, in

Digitized by Google

rows of three, five, seven, or three, six, eight, besides three or one small one at the shoulder, so that the total number appears to be always eighteen.

As they cannot fly, it is difficult to conceive how in a country so thinly inhabited by animals as that where they are found, they can obtain sufficient food, unless they can resist starvation to an uncommon degree. This appears the case, for some of them still showed signs of life when they were handed to me, after they had been in possession of the donor for many months.

The commonest species about Adelaide is *Trox litigiosus*, Har.—a grey beetle half an inch long, and usually found under rather dry carcases of cattle or sheep. It is rather beneficial than otherwise.

Note on Ogyris Amaryllis, Newm.: an Addition to the S. Australian Butterflies.

By Mr. J. G. O. Tepper, F.L.S.

[Read July 6,, 1886.]

It is a notable fact that within some twenty odd years several butterflies, or Papilionidæ, have made their appearance here, which formerly were only obtained from Eastern Australia, as for example the red and black *Danais Archippus* and *Danais Chrysippus*. To these is now to be added the above, for in February last I received several specimens from the neighbourhood of Edithburgh, Y.P., by Mr. J. G. McDougall. They do not appear to have been rare at the time and place indicated above.

The species is described and figured in W. C. Hewitson's catalogue of Lycænidæ, 1862 (issued by the British Museum), page 3, Plate I., figs. 5 and 6, but the description as well as the figures only apply to the female, with which the specimens agree well. The male differs much, and appears to have been unknown to the authors cited. I append Hewitson's description of the female, and add that of the male:—

"*Ogyris Amaryllis*, Newman, MS.

"Upper side dark brown. Both wings from the base to beyond the middle light blue. [Upper margin of the same interrupted by a square patch of intense black at the end of the cell.—O.T.] The costal margin of the anterior wing—

Digitized by Google

[not in all specimens well defined.—O.T.]—and the outer margin of both wings white.

"UNDER SIDE.—Anterior wing dark brown, lighter towards the anal angle; the apex and outer margin light grey, crossed by submarginal bands of brown; two spots of scarlet (bordered with light blue), and a white spot within the cell. Posterior wing light grey, clouded at the middle and outer margins with rufous brown, marked near the base with four spots of the same colour."

Male. Smaller than the female.

UPPER SIDE.—Both wings from the base light blue. The *apex and outer margin* of the anterior and the teeth of the posterior wings *black*, with a very narrow whitish fringe.

UNDER SIDE.—Anterior wing dark brown, lighter towards the anal angle; the apex and outer margin light grey, crossed by *a very narrow marginal and submarginal* brownish band; *five narrow bands* (broadening from the base) *between the costal and discoidal vein*, the second and third blue, the fourth white, edged with blue, the remainder white. Posterior wing light grey, *with slightly darker interrupted bands, narrowly edged with black.*

Digitized by Google

On the Production and Measurement of Gold and other Metallic Spheres to Determine their Weight.

By Mr. G. Goyder, Jun.

[Read July 6, 1886.]

In making assays for gold where the amount of gold is very small a little silver is required in which the gold may be collected. As nearly all commercial litharge contains silver it is rarely necessary to add any separately for this purpose. The litharge I at present use contains at the rate of six pennyweights of silver and one-seventh of a grain of gold per ton.

Having obtained a prill in which the amount of gold is a third, or less than the silver, the prill is boiled in dilute nitric acid in a porcelain capsule, to dissolve the silver; and where the amount of gold is more than one pennyweight to the ton, a second boiling in strong nitric acid should be given. If care be taken in using dilute acid at first and boiling gently the gold will be left in one piece of a nearly black colour. The acid is now decanted off, and the gold washed two or three times with distilled water. The gold may now be placed on an aluminium or other polished metal plate by inverting the capsule and leading the last drop of water and the gold with a glass rod on to the plate; the water is drawn off by a piece of filter paper, and the plate gently heated till dry.

Having thus obtained the gold in a pure state, a bead is made with boracic acid on a platinum wire loop, and pressed on the gold while still red hot. The gold adheres without difficulty, and by heating the bead before the blowpipe the gold is obtained as an almost perfect sphere. Should the resulting sphere of gold be very minute it is better to measure it under the microscope while in the bead, but if large enough to be seen with the naked eye it can be measured more accurately after dissolving the boracic acid bead in a watch glass with hot water, and placing the sphere of gold on a glass slide.

The plan of measuring minute prills of silver and gold to determine their weight was first introduced by Harkort, who used an ivory scale engraved with two fine lines, meeting at an acute angle, and divided into fifty equal parts. According to the fifth edition of Plattner's "Probirkunst," page 520, Goldschmidt determines the weight of silver and gold prills by

Digitized by Google

measurement with the microscope. As I have not access to the paper on the subject his manner of preparing the prills for measurement is unknown to me. Harkort and Plattner in making scales for the determination of the weight of gold and silver prills weighed prills corresponding to the larger divisions of the scale, and from their weight calculated the weight for the smaller divisions. These prills were taken direct from the cupel, and at the point of contact are flattened, but as the amount of flattening is not always the same and hardly varies in extent with the size of the prill, and as the converging lines on the scale cannot be very sharply defined, this method is not capable of the same accuracy as where the almost perfect spheres are measured with the microscope.

No other flux seems to possess advantages equal to those of boracic acid for obtaining a sphere of gold. Borax and other fluxes are so fluid when hot that the gold is very liable to alloy with the platinum wire; this rarely occurs with boracic acid, on account of its great viscosity, even when white hot. Boracic acid is also easily soluble in water, so that the gold spheres can be separated without loss of time.

The following rules and figures may be useful to anyone wishing to adopt the system here described:—

1. The weight of a sphere increases as the cube of the diameter.

2. The weight of a sphere of any substance of which the specific gravity is known is obtained by multiplying the weight of a unit sphere of water by the specific gravity of the substance and the cube of the diameter.

Constants for use with gramme weights—

1 weight of a sphere of water 0·01 mm. in diameter= 0·0000000005236 of a gramme.

2. Weight of a sphere of gold 0·01 mm. in diameter= 0·0000000102102 of a gramme.

3. Weight of a sphere of gold 0·0x mm. in diameter, $x^3 \times$ 0·0000000102102 of a gramme.

4. If 20 grammes of ore are taken for assay the number of grains of gold per ton is found by $x^3 \times 0{\cdot}008004$ in which x=the diameter of the sphere of gold in hundredths of a millimetre.

Constants for use with grain weights—

1. Weight of a sphere of water 0·001 inch in diameter= 0·0000001324 of a grain.

2. Weight of a sphere of gold 0·001 inch in diameter= 0·000002582 of a grain.

3. Weight of a sphere of gold 0·00x inch in diameter, $x^3 \times$ 0·000002582 of a grain.

4. Two hundred grains of ore being taken for assay the number

Digitized by Google

of grains of gold per ton is found by $x^3 \times 0{\cdot}2045288$, in which x=the diameter of the sphere of gold in thousandths of an inch. By taking 978 grains for assay x^3= grains of gold per ton.

To test the accuracy of the above figures a comparatively speaking large sphere of gold from an assay was measured, and found to be 0·593 mm., or $\frac{59{\cdot}3}{100}$ of a millimetre in diameter, and $59{\cdot}3^3 \times 0{\cdot}000000102102 = 0{\cdot}002129$ of a gramme. When weighed on a very delicate balance it was found to weigh 0·0021 gramme, and as this balance does not indicate beyond the fourth decimal the results may be considered identical. This sphere indicated gold in the sample tried at the rate of 3 ozs. 9 dwts. 13 grs. per ton. The smallest sphere of gold I have yet measured was 0·024 mm. in diameter, and by applying the above rule the weight would be $2{\cdot}4^3 \times 0{\cdot}0000000102102 \times 15{\cdot}43235$ (to convert grammes to grains)=0·000002178, or a trifle over two millionths of a grain.

Spheres of silver may be obtained and measured in a similar manner; the boracic acid acts slightly on the silver, but the quantity dissolved is inappreciable, as the action is not prolonged. The specific gravity of silver being 10·53 the weight of $\frac{1}{100}$ mm. would be $0{\cdot}0000000005236 \times 10{\cdot}53 = 0{\cdot}000000005513508$ of a gramme. In a test assay made with silver the sphere measured $0{\cdot}57 = \frac{57}{100}$ of a mm., from which the weight deducted would be 0·00102096 of a grain, the balance showing the weight as 0·0010.

Copper, lead, and other metals cannot be melted in boracic acid on platinum wire without dissolving to a perceptible amount, but may with care be melted in sodic carbonate, and by dissolving the latter in hot water the sphere of copper, &c., obtained and measured.

Digitized by Google

On "The British Standards."

By Mr. R. B. Lucas.

[Read December 1, 1885.]

Plates VII.-XIII.

I need not lay any stress upon the importance of absolute accuracy of measurement, and especially of standards being accurate, and though to those unconnected with scientific matters such errors as are observed and corrected in verifying standards would seem unimportant, yet scientifically the dimensions treated of will be quite appreciable.

It has been found that "no two primary standards, even, have ever been compared between which some difference has not been found," and this being the case it becomes a question as to the limit of error, or put in another form, the amount of trouble to which it is advisable to go in order to obtain the highest amount of accuracy.

The British Board of Trade has settled that the limit of error to be allowed in the standard yard line measures is not to exceed ·003 of an inch, or $\frac{1}{12000}$ of the yard which corresponds to a range of temperature of 10° Fahr. The actual expansion of the metal of which primary standards are usually made is ·000341 inch for each degree of Fahr. This metal is a mixture of copper, sixteen ounces; tin, two and a half ounces; zinc, one ounce; and is called "Baily's metal."

To observe with sufficient closeness to note such dimensions, a comparing apparatus, fitted with microscopes, has been designed by Mr. Sheepshanks, a well-known authority in such matters, and is now in use at the Board of Trade offices at Westminster, where all the standards are kept.

When in London lately I met with the most courteous reception by Mr. Chaney, the warden of the standards, who has expressed and shown a willingness to distribute information on these matters that is highly praiseworthy. When it is possible to obtain valuable information from so high an authority given so generously it is unwise not to seek it. I accordingly made use of the opportunity, and am now in the possession of a mass of valuable information on the subject.

It was not until the year 1867 that the British Government saw the importance of establishing upon a firm and reliable basis a set of standards, devoting to the purpose a special

Digitized by Google

department of the Board of Trade, now called the Standards Department, and appointing a staff of officials to carry it on. The Commission, which was appointed to inquire into the matter, consisted of G. B. Airy (Astronomer Royal), chairman; Lord Colchester, Right Hon. S. Cave, M.P., Sir J. G. S. Lefevre, K.C.B., the President of the Royal Society (General Sabine), the Master of the Mint (Professor Graham), Professor W. H. Miller, F.R.S., and the Warden of the Standards (then Mr. Chisholm).

They carried on their labours for three years, and on July 30th, 1870, handed in their fifth and final report, bearing date 1871. This comprehensive report embodies the results of the work of the Commission during those three years, and is itself the basis upon which the Imperial Weights and Measures Act, of 1878, was constructed, and is, indeed, the foundation upon which the law relating to weights and measures of all British dependencies is constructed. Our Act, of 1885, just passed, is in all the technical detail entirely based on it. So are the Victorian, Canadian, and other Acts. It is from this source that much of the information for this paper is drawn.

With reference to extreme accuracy of measurement and the carrying of such refinements to a degree that practical people might consider an extreme, we have an example in the French system. French technical departments are distinguished for their tendency to carry on these "refinements of science," and their attendant theories. This tendency has borne magnificent fruit in the shape of the Metric system, and this not only of a scientific but of an eminently practical nature. There is little doubt that within the next few years the Metric system will have made great strides, as it has done within the last five or six years. An International Metric Bureau sits in Paris in September of every year, at which questions concerning the introduction of the metric system throughout the world are discussed, as also other questions of weights and measures. This system is legalised in England and the United States, and is in force in Germany, Russia, France, and numerous other parts of the world.

The state of the British Standards in 1758 is an illustration of the looseness and irregularity resulting from an uncertain system and imperfect supervision. They were compared by Mr. Harris, then Master of the Mint, having at that time been in use for 170 years. This was simply a comparison of one with another, and had no reference to any fixed or primary standard, such a thing being at that time without form and void. "It was found that such wide discrepancies existed when one standard was compared with another in whatever way they were tried that the operators immediately turned

Digitized by Google

their attention (as they themselves expressed it) to ascertain some standard which should be uniform and to preserve a due proportion as well in its parts as in its multiples."

Notwithstanding the defects in all these standards made in the reign of Elizabeth, they continued to be used at the Exchequer until 1825, when they were superseded by the standards then established by law, the standard of capacity having been again replaced in 1834.

It must be remembered that the comparison of these standards was conducted without any of the refinements now considered necessary, and I doubt if even a normal temperature was defined, or if temperature was observed at all, or if the effect of specific gravity was recognised in these verifications. The scales and other comparing apparatus must at that time have been of a crude and unreliable kind, as the results published in the fifth report of the Commissioners seem to indicate. Even in the smaller weights such large fractions of a grain as the quarter and half were very doubtful quantities.

The limit of error settled by the Commission for the one ounce troy weight is the $\frac{1}{4800}$, or ·100 of a grain, the same as for the one pound troy, which in the latter case is the $\frac{1}{57600}$ of the total weight, whereas the comparison referred to above shows that the errors between the standards themselves in the possession of the Exchequer amounted to, for the one ounce troy, the $\frac{1}{960}$, or half a grain.

It is specified that the balance used in modern verifications of such weights as one-eighth of an ounce up to one ounce is "a balance with gun-metal beams, steel knife edge, and agate planes, made by Messrs. Ladd & Oertling, No. 4, to weigh from one ounce to one grain, to turn with the ·005 of a grain." The vast difference between an observation which takes note of the ·005 of a grain, and that which is very doubtful about the ·250 of a grain is significant enough.

LENGTH.

If we look back to the origin of weights and of measures of capacity (for the idea of making capacity a scientific derivative of length or weight appears to be of very modern application) we shall find nothing but confusion, and no sign of concordance or system; but if we turn our attention to measures of length we shall find some indication of a natural unit of length, more or less vague, but the concordance is somewhat remarkable. Upon an examination of the diagram, Plate VII., the idea will suggest itself that the step or human stride, or the human foot, formed the basis of most of such measures among the countries or nations there represented. The most natural way of roughly estimating the distance from

Digitized by Google

one point to another on the ground is to pace it. Roughly, the foot will be found to be about the third of a step and approximate to twelve inches, which will allow for the rough covering in the form of sandals or shoes, and the step will be very nearly a yard. With reference to the metre 39·37 in., the estimated ten millionth part of a quadrant of a meridian, which corresponds very closely with the length of a pendulum beating seconds at the equator, viz., 39·013 in., it is only an arbitrary measure after all, and has after each careful measurement of an arc differed, but its approximation to the more primitive yard and three-foot measures suggests the idea that it originated in these; for the five-millionth or any other fraction on the quadrant might just as well have been adopted, for the matter of that. One reason of its adoption was that it closely corresponded with the measures in use at the time and previously. It is more than a coincidence. The diagram speaks for itself, and I need not delay over this any longer, but can proceed to a description of the British standard measures.

The excellence of a principle is in proportion to its simplicity; hence the metric system, which demands only one arbitrary unit, is superior in that respect to ours, which requires two., viz., length and weight. In the British system one arbitrary unit of length and one arbitrary unit of weight being agreed upon and fixed by Act of Parliament, all others are derived from these. Hence the yard and pound specially legalised by the Imperial Act of 1878 are called the "Primary Imperial Standards," and all others are called "Derived Standards," capacity being based on clause 15 of this Act, which specifies that the gallon shall contain ten pounds weight of distilled water under certain conditions.

The present standard yard and the pound are the result of natural evolution, their history having been one of progressively accurate definition from time to time by Act of Parliament. The French have broken this chain of evolution by the arbitrary selection of the metre as a unit, but, as shown above, even this has been influenced by its prior history. Their idea was to avoid such a thing as an arbitrary standard at all, and if the actual length of an arc could ever be obtained, the thing is accomplished (but this will never be done); and in pursuance of this policy the kilogramme* and litre as units of weight and capacity respectively were based upon the measure of a given weight of water, everything thus being based *only* upon the metre. In short, we have *two* arbitrary units, the French have only *one*.

*The Kilo = the weight of one cubic decimetre of water; and the litre contains one kilogramme weight of water.

Digitized by Google

The latest stage in the development history of the yard and pound is their definition by Act referred to above, as follows:—"The following standards were constructed under the direction of the Commissioners of Her Majesty's Treasury, after the destruction of the former Imperial Standards in the fire at the Houses of Parliament in 1835:—

"The Imperial Standard for determining the length of the Imperial Standard yard is a solid square bar, thirty-eight inches long and one inch square in transverse section, the bar being of bronze or gun-metal; near to each end a cylindrical hole is sunk (the distance between the centres of each hole being thirty-six inches) to the depth of half an inch. At the centre of this hole is inserted in a smaller hole a gold plug or pin about one-tenth of an inch in diameter, and upon the surface of this pin there are cut three fine lines at intervals of about the one-hundredth part of an inch transverse to the axis of the bar, and two lines at nearly the same interval parallel to the axis of the bar. The measure of length of the Imperial Standard yard is given by the interval between the middle transversal line at one end and the middle transversal line at the other end, the part of each line which is employed being the point midway between the longitudinal lines; and the said points are in this Act referred to as the centres of the said gold plugs or pins; and such bar is marked—Copper, sixteen ounces; tin, two and a half ounces; zinc, one ounce; Mr. Baily's metal No. 1 Standard yard, at 62·00° Fahr. Cast in 1845. Troughton & Simms, London.

"The Imperial Standard for determining the weight of the Imperial Standard pound is of platinum, the form being that of a cylinder nearly 1·35 inches in height, and 1·15 inches in diameter, with a groove or channel round it whose middle is about ·34 inch below the top of the cylinder, for insertion of the points of the ivory fork by which it is to be lifted; the edges are carefully rounded off, and such standard pound is marked P.S., 1844, one pound."

It is then provided that four copies of the above, made at the same time, should be disposed of as follows:—One copy at the Royal Mint, one at the Royal Society, one at the Royal Observatory, Greenwich, and one immured in the New Palace at Westminster.

The originals are located in a strong-room at the Standards Department of the Board of Trade, at Old Palace Yard, Westminster, just adjoining Westminster Abbey. An immense number of derivatives of these are in the possession of the Board of Trade, and also numerous standards of purely historic interest. All the weighing and comparing instruments are deposited in the Old Jewel Tower (in the basement),

Digitized by Google

adjoining Westminster Abbey, which was a monk's refectory in days gone by. All coinage standards and sample coins are located under lock and key in the Pyx Tower, close adjoining. The standard photometer, described further on, is fixed in a small room with groined roof, attached to the old refectory; this was probably used by the monks of those days as a retiring-room, or possibly as a lavatory. The walls are blackened, as is usual, with open photometers. All these walls are of immense thickness, and of considerable age, and are so well set that the long measures, such as ten feet, are set out on them, and the results are found to be most accurate upon comparison with other standards.

When it is remembered that the linear expansion of stone is about ·00000652 of its length for one degree of Fahr., it will be seen that a practically permanent distance is maintained between the contact plates of the measure. It must be pointed out that the principal reasons for using those rooms are that being underground they are less liable to changes of temperature, and from their solid construction and age are free from any vibration or settlement.

Bed measures (or end measures) are those measures whose extreme length indicates the measure, and which are accompanied by a bed into which they fit between two end blocks; thus a subsidiary measure is formed by the bed, while the principal measure is generally the rod or bar. The process of verifying an inside measurement in a case in which the bed was the principal measure was accomplished by Captain Kater, the well-known authority on such matters, as follows:—The bed was of brass, with rectangular steel terminations, and the bar of brass, one inch square. Two bars of brass three-quarters of an inch square and a little less than eighteen inches long each were prepared; their ends formed true planes at right angles to their length. Upon the upper surface of each bar very near the end, a fine transverse line was drawn; the other ends of the bars were then placed in contact, and kept so by a spring, as shown in drawing.

The distance between the lines was taken by means of two micrometer microscopes, fixed to a bar of wood, and referred to Sir George Shuckburg's scale, which Captain Kater affirms does not sensibly differ from the Imperial Standard yard (see Plate VIII.). It was found that the error was 919 micrometer divisions—each division equal to $\frac{1}{23363}$ of an inch, or ·0000428 in. The two bars were then placed as shown in diagram No. 2 upon the standard to be examined, their marked ends together, and their opposite ends kept in contact with the steel faces of the standard by means of springs. Therefore the distance between the lines should, if the standard had been

Digitized by Google

correct, have equalled what the former distance lacked of three feet. The distance was measured, and from the mean of six observations was found to be 918·2 divisions of the micrometer, which Captain Kater says "differs so little from the 919 that this standard yard may be considered as perfectly correct." The amount of error was that the standard official yard was ·00003424 inch less than the Shuckburg scale, which error was of course not important enough to justify rejecting the measure. It was, however, considered by the Astronomer Royal that little importance was to be attached to the Shuckburg scale itself on account of its imperfections and the discordancies of its comparisons, and Mr. Sheepshanks (the designer of the present microscopic comparing instrument described below) did not place much trust in Kater's experiments, on account of the objectionable mode of resting the microscopical apparatus upon the scale. The idea of dividing a bar into approximate halves, as in this process, originated with Prof. Airy, the Astronomer Royal, who points out that "by placing two such end measures of a yard in a straight line end to end a line measure of a yard is formed, which may be compared with a line standard, and experience proves that line measures can be much more readily and accurately observed than end measures.

The microscopical comparing apparatus now used by the Standards Department consist of two principal parts—a travelling rest or stand for carrying the bars to be compared, and a fixed shelf of slate carrying four microscopes with micrometers, as per drawing (Plate IX.). The whole of the top part of the table, namely, the three plates of gun-metal, marked 1′ 1″ 1‴, and their connections, are enclosed after adjustment in a mahogany box, together with the measures to be compared attached to them, to prevent any variations of temperature during testing. As a further precaution a thick woollen rug is wrapped round this with holes cut in it for observation.

The micrometers of the microscopes were carefully rated, and it was determined provisionally that one division of the micrometer equalled ·00003173 inch—eventually settled at ·0000318 inch. This is the instrument used for the verification of line measures, or measures *à traits*, as they are termed; but for end measures, or measures *à bouts*, a specially-devised contact apparatus is employed. The instrument is made of brass, as per illustration (Plate IX.). By means of small contact pieces of steel, with fine lines engraved on gold studs upon them, the measures are converted into measures *à traits*. The contact pieces must first be *rated* by ascertaining the exact distance between the fine lines of the two pieces when in contact, and this constant always deducted from the observed measure gives the actual

Digitized by Google

length of the bar. (It has been found to be ·02014554 inch.) These contact pieces are not suited, however, for comparison of bars with square or rectangular terminations, and others have been prepared as shown in Plate IX., with small spherical projections. They are rectangular, and are made of gun-metal instead of steel. The distance between the lines in these studs has been determined to be ·099232876 inch. By means of these instruments measurements can be made accurately down to the ·00003187 of an inch, that being about the value of the micrometer division.

I need not detail the regulations to be observed for comparing standards by this instrument; it will suffice to say that most definite and precise instructions are laid down, and the greatest care is observed. The first observations are to be discarded, and only the subsequent readings to be taken as authentic.

The British Government, in rating the micrometer divisions, used an inch measure of Messrs. Troughton & Simms' very carefully divided into tenths and hundreds, together with a scale of its real errors. The defining lines upon their scales are cut upon silver, and like the lines in the gold studs of the Exchequer standards, are so fine that it is only in the strongest light that they are visible to the naked eye. To show the care considered necessary by this department, the breadth of the finest lines is nearly ten divisions of the micrometer, and the human hair is about 100 divisions.

The first work done by this instrument was the verifying the Victorian Standard yard in 1866, which is similar to the Imperial Standards, and is marked on sunk gold studs. I have seen this standard in Melbourne, and am of opinion that it is not a suitable form for these colonies. Under the Weights and Measures Act, 1885, which leaves the form of standard yard optional, and in accordance with advice received lately from Mr. Chaney, I am recommending a different form of yard measure.

The objection to the Victorian Standard is that to use it at all a comparing instrument similar to that above described is required, and this would be absurdly costly for us to employ; and again, there is no necessity for us to trouble about fourth decimals of an inch. The allowance of error recommended by the Commission in their report of 1841 was $\frac{1}{12000}$ of the whole, or ·003 inch to the yard. This corresponds with a range of temperature of ten degrees; and the necessary accuracy can be attained by means of much simpler standard known as the Canadian Standard, and marked S.S., which I am recommending, as mentioned above.

Amongst the instruments used in comparing lengths are the following:—An instrument for verifying measures of twenty

Digitized by Google

feet to ·01 inch, fitted with five microscopes and micrometers; calipers and micrometer for verifying measures of capacity; an apparatus for finding the expansion of metallic bars at varying temperatures from 32° Fahr. to 212° Fahr. Small test-glass used with micrometer microscopes, having minute subdivisions of the millemetre cut upon it, known as Nobert's lines. Nobert, the German optician, has ruled bands containing 224,000 lines to the inch; he regularly makes plates with bands consisting of from about 11,000 to 112,000 lines to the inch, numbered first to nineteenth, which are used as microscopic tests. It is of interest to note that the spaces between the lines on the nineteenth band are about half the length of a wave of violet light; and the length of such a wave being ·0000179 inch, and the micrometer being capable of measuring to the half of one division, viz., half of ·0000318, it follows that the yard can be measured to about the length of a wave of violet light.*

The department is furnished with a complete set of Whitworth's plugs and dies in form as per illustration (Plate X.), varying from six inches diameter down to ·1 of an inch by degrees of ·1 inch and ·01 inch. In connection with these is a set of three plugs and one die in a small case. The die is exactly one inch in diameter; one plug is exactly the same, but the other two plugs are 1·001 inches and ·999 inch diameter. The object of this is to enable one to judge of an accurate fit. Upon applying the plug one inch diameter I found that by keeping it moving, and turning it as I pushed it, I could pass the plug into the die and withdraw it; but if I allowed it to stop for a moment cohesion would take place, and some force was required to withdraw it.

When I applied the plug ·999 inch in diameter, it easily passed through, but without play, and without the experience of the one-inch plug would have appeared a perfect fit. The plug 1·001 inches in diameter would not pass in at all. These are all made by Sir Joseph Whitworth & Co., and are examples of perfect workmanship.

Wire Gauges.— With reference to wire gauges, dissatisfaction and uncertainty having previously existed, steps were taken under certain clauses of the Weights and Measures of 1878 to set this question at rest. At the Privy Council held on 23rd August, 1883, an order was made to legalise certain wire gauges, and establish them as standards under the Act; and although other gauges are in use, viz., a "Sheet and Hoop-iron Gauge" (South Staffordshire Ironmasters' Association), Stub's

* The periodical report by Board of Trade (of date February 6, 1882) refers to the subdivisions of the inch to the 100,000th by means of micrometer screws.

Digitized by Google

iron-wire gauge, and steel-wire gauges, no other but the Imperial Standard gauge is strictly legal.

Expansion by Heat.—General Baeyer some time ago pointed out a phenomenon with regard to the expansion of metallic bars by heat. He found upon careful verification of certain measuring bars used in measuring an arc of meridian that the co-efficient of expansion had sensibly decreased, while the length of the bars at their normal temperature had during twenty years remained the same. To explain this, he ventures three hypotheses—1st. That at each time the bars are subjected to increased temperature a step is made towards reducing the *temper* of the steel, and thus rendering it less expansive. 2nd. That a crystalline structure is set up by the vibrations and concussions these bars were subject to. 3rd. A somewhat complicated hypothesis, based on the fact that certain substances exist consisting of two sets of wholly different crystal systems, due to high and low temperatures, and that the bars remaining at ordinary temperature, there is a tendency to reduce the system of crystals to a third, corresponding to the medium temperature. He admits himself that this is least probable.

WEIGHTS.

The Imperial Weights and Measures Act, and Acts derived from this, specify the standard pound to be of platinum, and the weighing to be conducted in vacuo. The object of this will be evident—and is, of course, the elimination of the disturbing effect of specific gravity, and platinum being the densest of all metals is least influenced by the buoyancy of the air. As a matter of fact the comparisons are not usually made in vacuo, though provision is made for this, but careful observations of the barometer and thermometer are made and corrections applied—based upon the ascertained specific gravity of the compared and comparing weights. Indeed, to such a pitch of refinement and delicacy are verifications of important standards carried that the expansion of the metal due to temperature is observed and corrections are made for this. Professor Schumacher in his paper on "The Comparison of the late Imperial Standard Pound Weight with a Platina Copy of the Same and with Other Standards of Authority," read before the Royal Society in 1836, says:—"It is to be hoped that no pound will in future ever be declared a legal standard unless its specific gravity and expansion (the knowledge of which is indispensable, even for a single comparison with a good balance) are previously determined with the greatest possible precision."

As it has been decided that immersion in water is calculated to injure the standards, their density must be determined by

Digitized by Google

means of the stereometer, invented by M. Say, and used by Professor Miller. It is described as follows:—"It consists of two glass tubes of equal diameter communicating with each other at the bottom. One tube is graduated by lines traced on the glass; it is connected on the top to a cup capable of being closed airtight. The body to be tested is placed in this cup. The volume of air in this cup is measured by means of mercury poured into the other tube, by which the graduated tube becomes a barometric tube. The volume of the weight is shown by the difference of the volume of air before and after the standard weight is inserted in the cup. By means of this instrument the specific gravity of soluble bodies, gunpowder, &c., may be ascertained without injuring them."

In order, therefore, to ascertain the true relative weights, as well as the actual weights of standards differing in density when weighed in air, it is necessary to allow for the weight of the volume of air displaced by each standard. Thus, in weighing two standards of different material for the purpose of determining their relative weights, it becomes necessary to reduce these weighings to a vacuum by deducting the weight of the volume of air displaced by each of them.

The correction is to be made according to the formula, thus given by Professor Miller:—"If the weights of P and Q appear to be equal when weighed in air, then the weight of P — weight of air displaced by P = the weight of Q — weight of air displaced by Q." As a body when weighed in water weighs less than when weighed in air, by the difference of the weight of air and the weight of water displaced by its volume, in the same manner a body weighed in air weighs less than when weighed in a vacuum, by the weight of air which its volume displaces.

But the weight of air is affected by temperature, aqueous saturation, &c., hence the correction is to be ascertained from the following data:—

1st. Mean temperature of the air during comparison.
2nd. The mean barometric pressure reduced to 30° Fahr., and corrected by deducting the pressure of vapour in the air.
3rd. The density of the metal of which each standard is composed.
4th. Its co-efficient of expansion.
5th. The apparent weight of each standard.

And the method of computing the weight in grains of air displaced by each standard is by adding the logs. of the following terms:—

1st. The given barometric pressure in air, corrected and reduced to 30° Fahr.

Digitized by Google

2nd. The given ratio of the density of the air to the maximum density of water.

3rd. The ratio of the density of the metal of which the standard is composed at 0° to its density at the given temperature, and co-efficient of the lineal expansion of the metal.

4th. The weight of the standard in grains, and by deducting from the sum the loss.

5th. The ratio of the density of the standard at 0° to the maximum density of water.

In these calculations the latitude of the place of observation together with its elevation above normal sea level have to be taken into account.

In order to observe the needle of the balance with an accuracy commensurate with such corrections as I have described, it has been found necessary to use microscopes.

To the balance known in the department as Barrow's Balance two microscopes with a single horizontal hair line have been attached, so that two persons can simultaneously observe each needle. Provision is made for illuminating the scale if required. A double glass screen is placed between the observers and the balance, and an arrangement is provided for shifting the pans from one arm to the other without opening the glass case in which the balance is contained. A holder is fixed to carry two thermometers, so as to adjust the bulbs to the level of the centres of gravity of the weights in each pan.

A vacuum balance to weigh up to one kilogramme (made by Oertling) was shown to me by Mr. Chaney, of which the drawing in Plate XI. is a sketch from memory. This, I understand, is only used occasionally as a test after the process above described has been effected. It is not in common use. A powerful air-pump, constructed by Troughton & Simms, was used in connection with this balance, and almost a perfect vacuum could be obtained. The glass is one and three-quarter inches thick. The balance is provided with thermometers, gauge, and arms for removing and changing the pans and removing the weights. These are not made air-tight by stuffing boxes, but are sealed by a 30-in. seal of mercury, which hangs down underneath the table. Very minute weights can be observed with this instrument. I was also shown a small scales weighing down to the ·0001 of a grain, which is to carry weights up to one ounce.

The beam is formed of filaments as fine as hairs braced together for stiffness.

Another balance was shown to me, enclosed, as is usual, in a glass case; the scale was read by a telescope, by which means the observer could be removed twenty feet away from the instrument to avoid disturbing the temperature by the heat of the body.

Digitized by Google

The mode of using the scales is as follows:—The standard to be compared is placed in the left-hand pan and the comparing standard in the right-hand pan. The divisions and fractions of a division which would be pointed out by the index on the ivory scale attached, if the beam were allowed to come to a state of rest, are ascertained by taking the mean of the extreme of the vibrations when the extent does not exceed the limit of the ivory scale, and it is presumed greater accuracy is thus obtained than if the balance came to a state of rest. The standards are then changed from right to left-hand pans, and similar observations are made. The same process is repeated three or six times or more. Half the difference between these two means shows the difference between the two weights in divisions of the index or ivory scale, and this when converted into parts of a grain shows the actual difference in weight.

There are two gilt gun-metal copies of the Imperial Standard Pound deposited in the Standards Department, No. 31 of 1845, which is ·00008 grain heavier than the standard, and No. 34, which is ·000089 grain lighter. As the combined weight of the two standard pounds is thus correct to ·000009 grains, their mean weight may be assumed to be equal to the Imperial Standard, and to form a true basis of comparison. These weights have therefore been used for such verifications, the average of their weight being assumed to be absolutely correct.

It might at first sight be considered that a weight standard once proved correct would remain so practically for ever. But such is not the case, and variations have been proved to have taken place.

Weights will increase and decrease in weight according to whether they are used or not. If not used they increase by oxidation, and if used they decrease by wear. The official standard pound which had been in use since 1825, when compared in 1866 with Captain Kater's primary brass pound, No. 1, which had never been used, and of which it is a copy, was found in the mean of five comparisons to be ·90177 grain lighter. This has been assumed to be the loss of weight due to wear and tear in 40 years. I consider we must also assume that so careful an observer as Captain Kater could not have overlooked so great a difference. As an instance of increasing in weight, Captain Kater's pound, No. 5, was compared in 1824, and again in 1844, and in these 20 years it had gained ·0089 grains by oxidation, and upon comparing again in 1867 it had gained ·01698 grains in the next 23 years. The accuracy of this has been questioned, but there can be no doubt of an increase in weight.

An illustration of different forms of one-pound weights, half full size, is given (Plate XI.) to give an idea of their specific gravities.

Digitized by Google

CAPACITY.

The universal unit of capacity by which all liquids and dry goods shall be measured is the gallon defined in clause 15 of Act of 1878 as containing ten pounds of distilled water weighed in air at a temperature of 62° Fahr. and thirty inches barometer against brass weights. The single exception to this is the apothecaries' fluid ounce, being the measure of an ounce weight of water. This is the same as the troy ounce, and the apothecaries' grain is the same as the avoirdupois grain.

The gallon forms the basis of all liquid measures, and the bushel of eight gallons of all dry measures. The bushel is defined in Act of 1878 to be a hollow cylinder having a plane base, the internal diameter of which shall be double the internal depth.

There are three possible modes of verifying measures of capacity:—

1st. By lineal measurement and cubing the contents.

2nd. By measuring the quantity of water contained.

3rd. By weighing the water contained.

The first mode has seldom been resorted to, and is not reliable or capable of any accuracy. The second is the mode adopted in all ordinary verifications. The third is used in scientific verifications and researches, and though capable of ensuring the greatest accuracy of any system, requires careful observation and many corrections.

The second mode (measuring with water) is effected as follows at the Standards Department. The standard and measure to be compared are left together in the same room with the water to be employed for twenty-four hours, in order to secure equal temperatures. First, the standard is accurately levelled, and then slowly filled by a small syphon until the water appears slightly elevated above the rim. Any air bubbles are carefully removed with a quill. A circular plate of glass with a plane surface and a small hole in the centre in a depressed cup is gently slid over, pushing off any superfluous water. Any water appearing in the small cup in the centre is removed by a pipette. The measure to be compared is also accurately levelled, then filled with water, emptied and drained, and the water from the standard is transferred by a syphon. The syphon itself is similarly filled and drained before using. The object of this precaution is evident. The glass plane, with any water that may be on it, is now slid over the measure. The excess or deficiency is measured by means of a burette.

Weighing—the more scientific process—is implied by the Act of 1878, clause 15, which defines the size of the unit of capacity by specifying the weight of water contained therein. It therefore follows that this mode more closely conforms with the

Digitized by Google

spirit of the Act, and hence in any official scientific verifications this mode is adopted. The tare of the vessel to be examined, together with the glass plate, is taken, and this weight, together with the weight of water it should contain, is placed in one pan of the scales, and in the other the measure filled with water. The errors due to temperature and barometric pressure are observed, and balanced by means of weights in either pan, according as the error is plus or minus. If correct, the balance will be in equilibrium. As a difference of 1° Fahr. between 62° and 70° will occasion an error of from four to six grains in the gallon, or thirty-two to forty-eight in the bushel, the importance of observing the temperature will be evident.

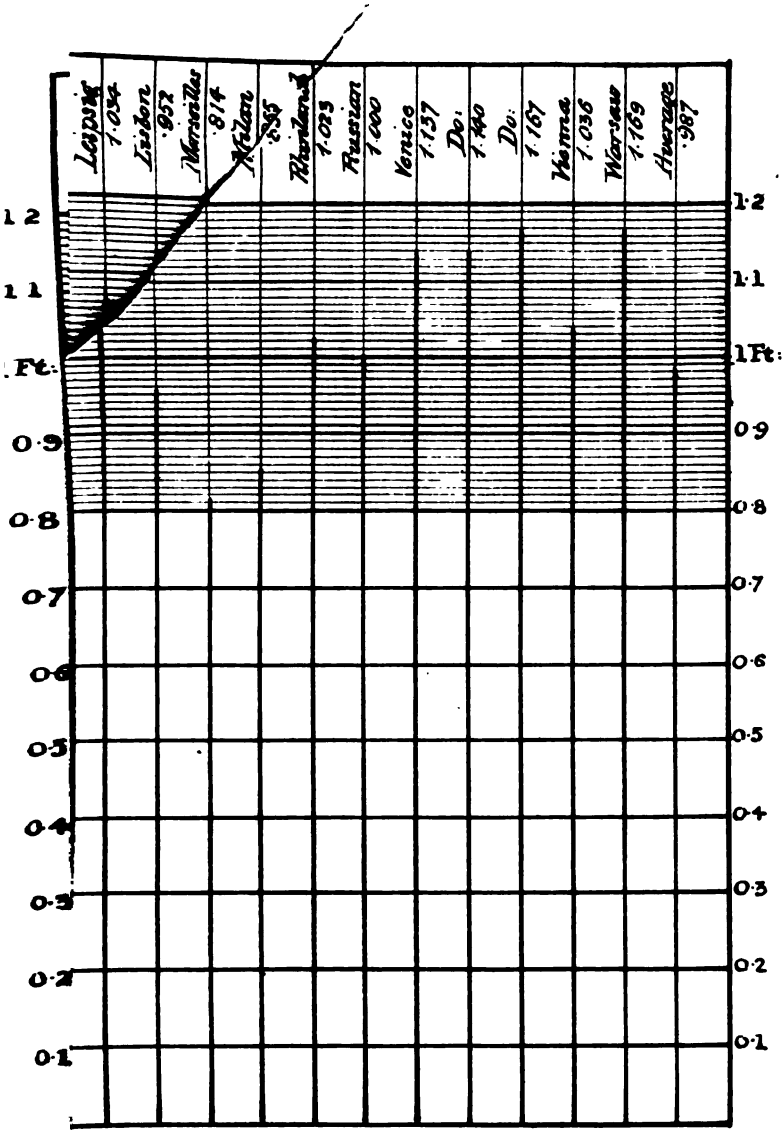
The reason for specifying brass weights by the Act will be evident after the observations on specific gravity of weights, and it is done to fix the conditions; but as the specific gravity of water is very different to that of brass, it appears to me that consistency demands the same scientific accuracy in this point as in others, especially when it is remembered that as fine, or finer, corrections are applied which are due to other circumstances; and even the weighing of the platinum pound weight, which is so little affected by the buoyancy of the air on account of its great specific gravity, has to be reduced to vacuo.

Captain Kater, in his researches, takes the weight of brass as eight times that of water; the effect, therefore, of the buoyancy of the air upon the brass will be one-eighth of that upon the water, thus lessening the effect on the water by about one-eighth of the whole quantity.* The calculation to give the correction is $\frac{1}{2,490} \times \frac{7}{8} \times 70{,}000$ grains = 2·46 grains = the gain in the weight of water due to a depression of one inch of the barometer in one gallon. Since Kater's inquiries further researches have been made by other scientists, especially by Regnalt, whose results are accepted throughout Europe as authoritative. It is true that this correction may be made now in official comparisons, but I can find no account of it, and I omitted to ask Mr. Chaney if it were observed when I saw him.

With reference to the expansion of gases under varying conditions something has to be said further on under the head of gas measurement. The question of saturation somewhat complicates the matter, which would otherwise be simple and satisfactory; but with reference to water and the expansion of liquids generally there is little satisfaction. The expansion of water by heat is, as we know, subject to the, as yet, unaccountable phenomenon that from 32° to 39° it contracts, and from

* Water is taken as 831 times the weight of air; this, multiplied by thirty inches barometer for the pressure of air, gives 24,930.

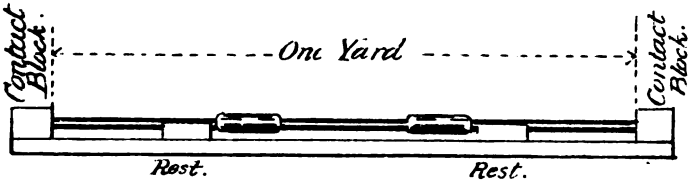
Digitized by Google



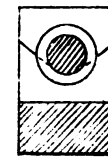
Digitized by Google

Digitized by Google

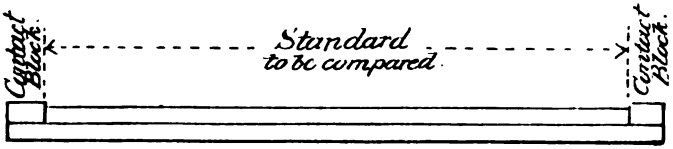
ORDINARY BED STANDARD.



Steel Bed with Bronze Bar
Scale 1 in. = 1 Ft.

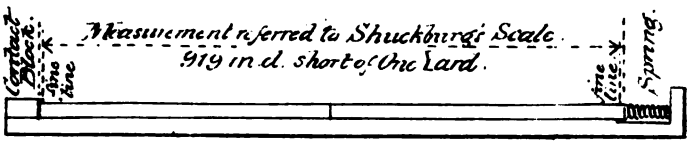


Section
3 in. = 1 Foot.



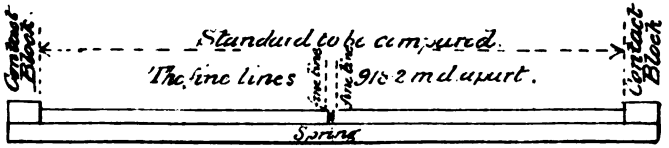
Brass Bar 1 in. square and Brass Bed.
Scale 1 in. = 1 ft.

Section.
3 in. = 1 ft.



Two Brass Bars 3/4" square.
Scale 1 in. = 1 ft.

No 1.



Two Brass Bars 3/4" square.
Scale 1 in. = 1 ft.

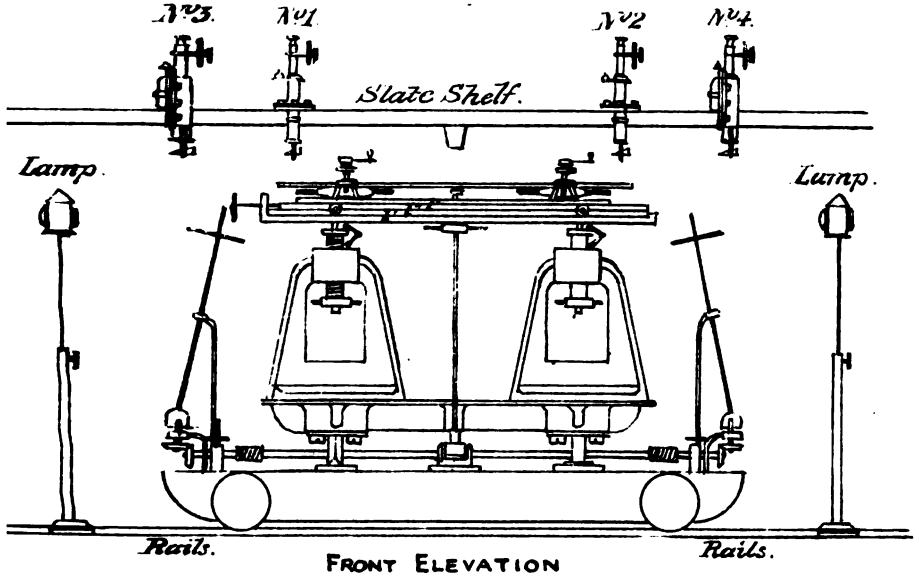
No 2.

R.B.L. del.

Digitized by Google

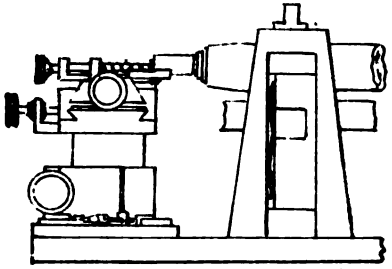
Digitized by Google

MICROSCOPIC COMPARING APPARATUS.

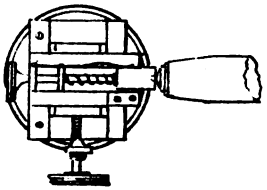


FRONT ELEVATION

Scale 45 mm



ELEVATION. (One quarter full size.)



PLAN.

CONTACT APPARATUS.

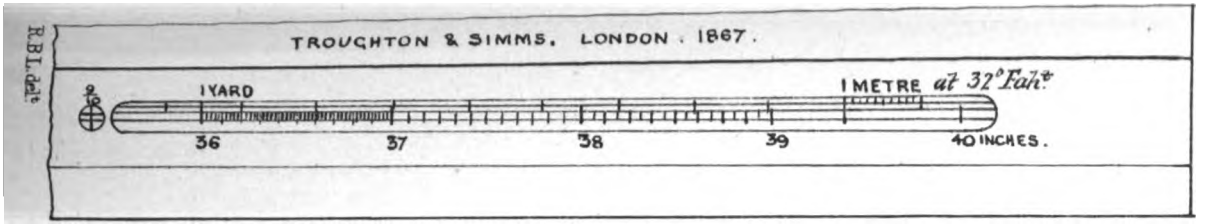
CONTACT PIECES FOR SPHERICAL ENDS.

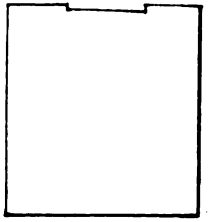
R.B.L. del.

CONTACT PIECES FOR SQUARE ENDS.

Digitized by Google

Digitized by Google

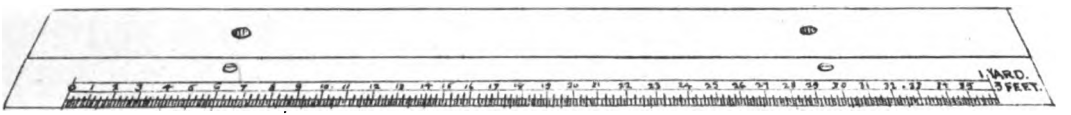




THE CANADIAN STANDARD S.S.

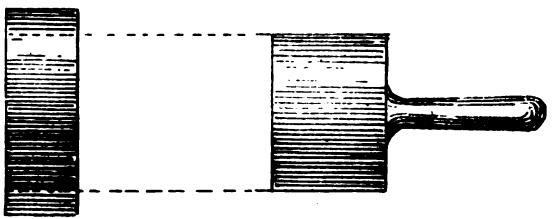
RIGHT HAND END OF UPPER SURFACE OF BRONZE BAR WITH YARD & METRE SUBDIVISIONS.

TRANSVERSE SECTION OF THE BAR.



FORM OF BEVELLED EDGE STANDARD.

WHITWORTH'S GUAGES.



COLLAR. PLUG.

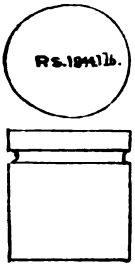
Plate X.

Digitized by Google

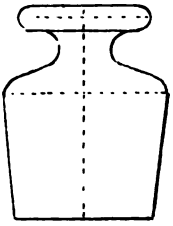
Digitized by Google

5 STANDARD AND OTHER POUND WEIGHTS.

OF VARIOUS SCALE — to No 31 — MATERIALS. ½ FULL SIZE.

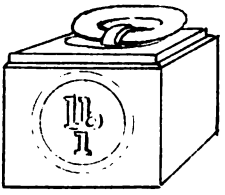


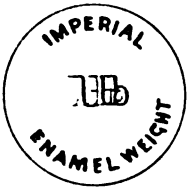
IMPERIAL STANDARD PLATINUM POUND.

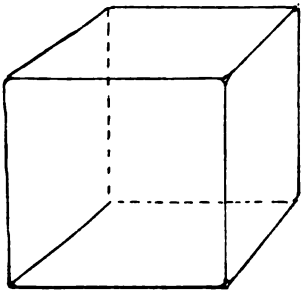


OFFICIAL STANDARD GILT GUN METAL POUND

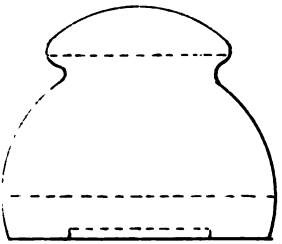
ORDINARY IRON TRADESMAN'S WEIGHT



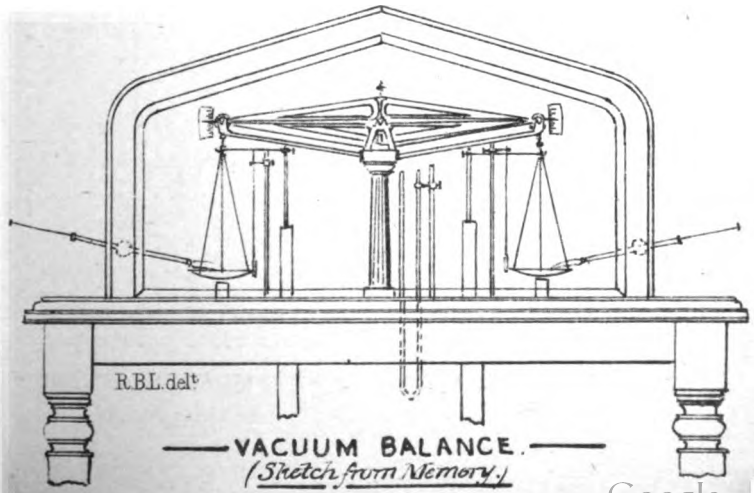




QUARTZ POUND WEIGHT.



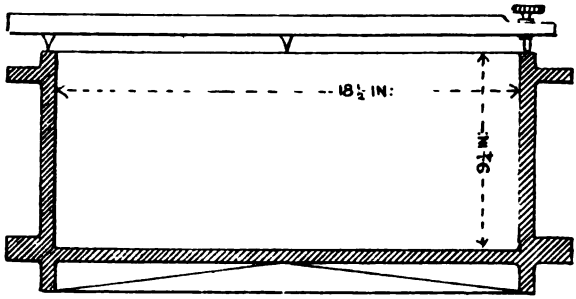
ORDINARY EARTHENWARE TRADESMAN'S WEIGHT.



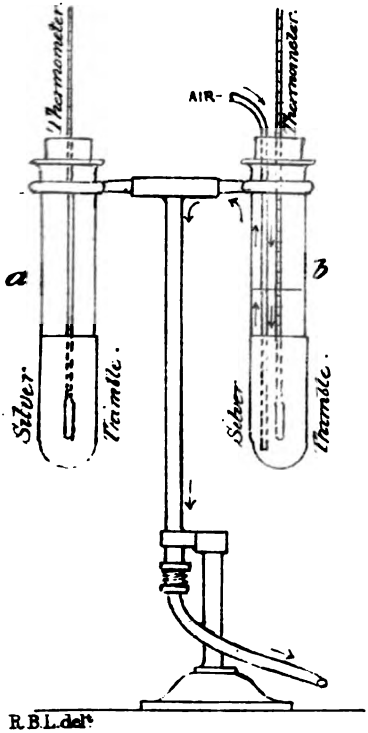
VACUUM BALANCE.
(Sketch from Memory.)

Digitized by Google

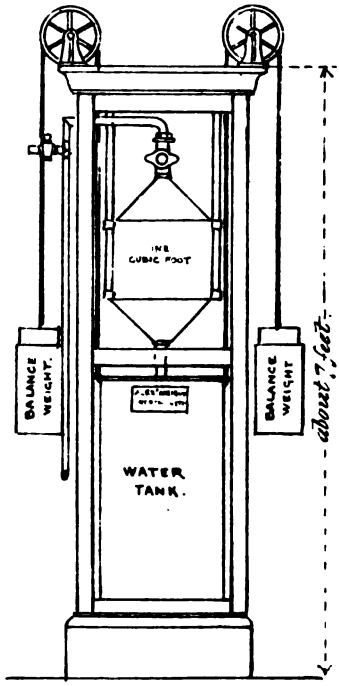
Digitized by Google



SECTION OF
IMPERIAL STANDARD BUSHEL.
With Weiler Exac. Adjuster.



R.B.L. del.
M. REGNALTS HYGROMETER.
One third of natural size.

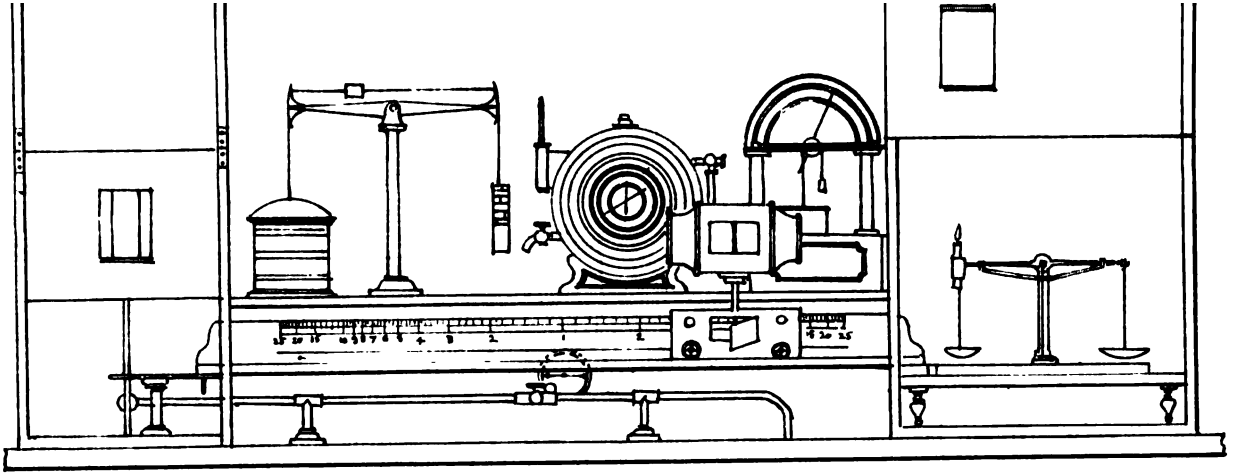


STANDARD CUBIC FOOT
BOTTLE.

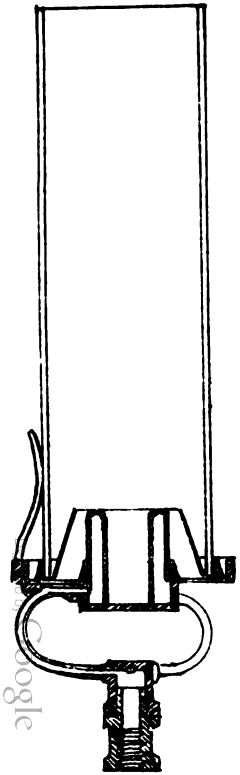
Digitized by Google

Digitized by Google

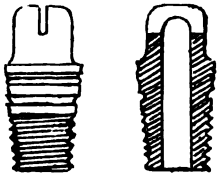
R.B.L. del.



LETHEBY BUNSEN
OR OPEN PHOTOMETER.



LONDON STANDARD
ARGAND BURNER.
(HALF FULL SIZE)



(FULL SIZE)
STANDARD BURNER
FOR
CANNEL GAS.

METHVEN'S
ILLUMINATING
POWER
STANDARD.

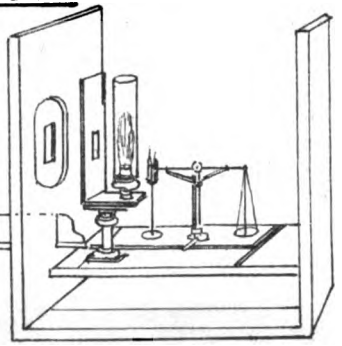


Plate XIII.

Digitized by Google

Digitized by Google

that point upwards expands in the same ratio as it previously contracted, a fact which complicates finer researches.

Considerable difficulties have been experienced in obtaining consistent results in verifying the bushel. The chief seems to be the large area of the surface (viz., 18½ in. diameter), and the consequent difficulty of getting a true water surface. The drawing in Plate XII. shows a water-line indicator attached to a bushel measure. This is, I understand, now used in preference to the glass plate at the Board of Trade. The reasons of errors in these verifications of the bushel measure are as follows:—

1st. Its difference of specific gravity caused by absorption of air, &c., from the atmosphere.
2nd. The evaporation of the water during the time necessarily occupied by the weighings.
3rd. Variations of temperature during the weighings.
4th. Difficulty of obtaining an exact plane of the surface of the water.

The importance of the last will be seen from the fact that a difference of ·001 inch in the height of the water line makes a difference of 31 grains. In view of these facts it has been proposed by Professor Miller (as the process of verifying a bushel measure is most troublesome on account of the great weight of water, and the necessity of filling the standard exactly up to the brim) that a form of standard measure more resembling the cubic foot bottle, used in gas measurement, would answer better.

GAS MEASURING.

The Sales of Gas Act of 1859 provides that certain instruments deposited with the Board of Trade should be regarded as standards for the sale of gas, chief among which is the cubic foot bottle, as shown in drawing. And the unit is thus specified, Clause II.:—"The only legal unit for the sale of gas by meter shall be the cubic foot, containing 62·321 pounds weight of distilled water, weighed in air at the temperature of 62° Far., the barometer being at 30 in." And the next clause provides for the construction of this and derived standards, and their deposit in the Standards Office. The mode of using the cubic foot bottle is by placing counterbalance weights upon the chains. The tank containing water is raised, and the measure is thus immersed, and the air contents expelled through the outlet at the top (Plate XII.). As soon as the water makes its appearance at the neck (seen through glass plates) the outlet cock is shut and a cubic foot of air has been expelled. The secondary standards take the form of small gasholders of five or ten feet capacity, carefully made and provided with a scale of cubic feet, divided into tenths and hundredths. The principal diffi-

Digitized by Google

culty exists in accurately graduating this scale for a particular bell, as the disturbing effects of varying temperature, &c., affect the result. The laws laid down by Boyle, Gay Lussac, and others that all gases expand and contract the same for the same temperature, that expansion is in direct ratio to the absolute temperature, and that the bulk is in inverse ratio to the pressure, only hold good so long as the gas under consideration is a perfect gas, and as soon as the vapour element is introduced all this is modified. As it happens that in practice gas and air are always more or less saturated with aqueous vapour the normal state must be taken as that of saturation. To meet this difficulty the Astronomer Royal in 1861 compiled a table of expansions of gas in contact with water at various temperatures, based upon factors supplied by J. Glaisher, F.R.S. It is said to be calculated in accordance with the best modern theories. It is the table used in official verifications of local standards at the Standards Department, and is found in all practical treatises on gas manufacture, but is of course not used in the scientific comparisons and verifications conducted at the department, as it is only calculated to one-half per cent., and much closer observations are required. As an example of the dilation I give an extract from the table:—

A volume of gas at	32°	Fahr. increases at	42°	by	2½ per cent.
"	32°	"	52°	"	5 "
"	32°	"	62°	"	7½ "
"	32°	"	72°	"	10 "

or about 2½ per cent. for each ten degrees of Fahrenheit. As the dilatation of pure or dessicated gases is in direct ratio to the absolute temperature, which is found by adding 459 to the Fahrenheit temperature, it will be found that the volume of a pure gas at 32° will increase 2·036 per cent. for every ten degrees of Fahrenheit, as against 2½ per cent. in the case of saturated gases.

In order to calculate such a table the amount of aqueous vapour in the air must be ascertained by determining the temperature of the dew point. This is done by means of M. Regnalt's hygrometer, as used by the British Standards Department (Plate XII.). It consists essentially of two test tubes of glass, each fitted with a silver thimble. Ether is poured in that marked *b*, and the air or gas bubbled through it; the temperature is thus reduced until dew is observed upon the silver thimble, and the temperature is observed by the thermometers. Of course the lower the temperature required to deposit dew the less vapour exists in the atmosphere or gas being tested.

The mode of verifying a cubic foot measure is very similar to that employed in weighing the contents of a bushel measure, and similar corrections are required. But in verifying the

Digitized by Google

derived measures, viz., the one cubit foot, the five cubic foot, and ten cubic foot holders at the Standards Department, the greatest precautions were taken to maintain the temperature of the water in the tanks of the holders and in the cistern of the cubic foot apparatus, the same as that of the air of the room by means of hot and cold water properly mixed. But with all these precautions, and the use of screens to keep the heat of the body from affecting the contents of the bells, there was frequently a difference of 1° Fahr. between the two measures.

The great difficulties experienced in maintaining a body of water at a uniform temperature led the Board of Trade to instruct the Cambridge Scientific Instrument Company to conduct experiments with a view to solve this question. The report of their inquiries, dated December, 1885, shows that the maximum variation of temperature in fourteen days was ·04° centigrade, while the variation in the room itself was about 4° centigrade. This was effected automatically, and the results are satisfactory so far.

In the first case water is used as a means of comparing the measures, as in the bushel measure, but in the latter saturated air has to be used, hence the difficulty is augmented.

The limit of error for official standards proposed by the Astronomer Royal and approved by the Treasury is ·005 for the cubic foot, ·025 for the five cubic foot, and ·05 for the ten cubic foot. As the errors in the above standards were proved to be, for the one cubic foot, —·00053 cubic foot; for the five cubic foot, —·00667 cubic foot; and for the ten cubic foot, —·02495 cubic foot, they were passed as correct, but these errors are allowed for and taken into consideration in using these standards.

Although these, viz., the cubic foot bottle and gasholders, are the only forms specially legalised, Clause III. of the Act gives power to adopt other forms, and under this clause "secondary derived standards" have been constructed and adopted, with the object of obtaining a portable standard. They take the form of wet meters, and are capable of almost absolute accuracy, as I have found myself. At our Standards room we have a 50 light and a 100 light meter as models under the Act of 1881, which were made by Alex. Wright & Co., and are very satisfactory.

COINAGE.

Amongst other standards of weight are coin weights, corresponding with the standard weight of each coin of the realm, and with these the coin weights used by Banks throughout England and by the Mint are verified.

The duty of verifying coin weights used by the public was

Digitized by Google

originally conducted at the Mint, but since the establishment of the Standards Department of the Board of Trade it has been relegated to that Department. I was informed by Mr. Chaney that sample coins are taken at haphazard from coinings, and deposited in a strong room in the Pyx Tower; at the end of the year they are taken out and verified carefully; by this means a check is maintained upon the accuracy of the work at the Royal Mint. As a rule these trials prove the errors, as to weight and fineness of the coins, to be far within the allowed limits, and I doubt if any case of condemning has occurred within late years. Glass weights are sometimes used by tradesmen to test gold coins.

LIGHT.

An Act of 1859 provides a standard of light, and modes and apparatus for testing lights. In accordance with this the necessary standard burners, photometer, &c., are deposited, amongst other standards, with the Board of Trade. The drawing in Plate XIII. will show one of the two authorised forms of photometers and the form of burner. The legal standard of light is the sperm candle of six to the pound, burning 120 grains of sperm per hour—the consumption of gas has to be adjusted to five feet per hour. The candle has been proved to be a most unsatisfactory standard, and there is at present a strong feeling in favour of some other form being legalised. The opinions lie between the Pentane standard of Vernon Harcourt and the Methven slit, which are the chief competitors.

Attention has lately been drawn to F. von Hefner Alteneck's amylacetate lamp, the extreme variations of which are claimed to lie within the limits of perception of the human eye, whereas the candle (the existing standard) is liable to variations as great as 23·7 per cent. in extreme cases, which would make eighteen-candle gas appear to be either fourteen or twenty-two candle power; whereas the eye is, if properly assisted, capable of judging to within about a fifth of a candle in eighteen-candle gas (say about one per cent).

For cannel gas a burner specially constructed is legalised.

The Pentane standard of Vernon Harcourt consists in using a specially-prepared gas from highly-rectified petroleum, which, burned under certain fixed conditions, he claims, gives a constant unit of light. John Methven's system is based on the assumption that by cutting off from an ordinary argand flame all but the central rays of light, by interposing a screen having a slot of fixed size, a constant unit is thus obtained. I found amongst authorities I met in England a very strong feeling in favour of the latter; and it is used at numerous testing stations throughout England by Companies and Corporations, but is not yet included in the British Standards.

Digitized by Google

An immense variety of propositions have been made from time to time with the object of establishing something like a definite unit of light, but up to this time with only partial success. The International Congress of electricians, assembled in Paris in May, 1884, adopted the proposal of M. Violle, fixing as the unit the quantity of light emitted by a thread of platinum of a thickness of a square centimetre heated to melting point, and tested at the moment of cooling; but difficulties occur in this which will effectually prevent it remaining the ultimatum.

It is a field of inquiry that to many scientists has a great fascination, and is now attracting much attention from specialists. I met persons in London who devoted the greater part of their time to researches in this direction, which will seem, however, to the general public a somewhat restricted specialty.

Some systems which have been proposed are as follows:—Keat's standard sixteen-candle oil lamp, the French Carcel oil lamp, Crooke's radiometer, the selenium photometer, Lewis Thompson's one-candle standard lamp, &c., &c.

The British Standards Department, besides carrying on the duties indicated above, give attention to such matters as the following:—Advising all British dependencies as to the best course to pursue in all matters relating to weights and measures; issuing reports periodically as to the business done under the Act, together with instructions and advice to inspectors as to the best mode of carrying on their duties; directions for testing all descriptions of weighing-machines; adjudging limits of errors to be allowed in weights and measures; inquiring into questions of various metal gauges and screw threads from time to time; attending international conferences in Paris and elsewhere as to the metric system, unification of longitude, &c.; testing petroleum-testing apparatus; conducting numerous scientific researches as to expansions and contractions of metals and other substances, together with other matters. It will be seen from this list that the scope is very wide and comprehensive.

CONCLUSION.

I have now described the British Imperial system of standards, which is, so far as it goes, excellent. But theoretically it is far from perfect. Standards of length, weight, capacity (dry, fluid, and gas), and light are alone represented; but an ideal system would represent besides these electric units and meters, atomic units, musical pitch, time, alcohol, temperature, motion and power, &c.

With regard to electricity, a unit is now taking form, and

Digitized by Google

something has already been done to secure his. The B. A. Ohm was determined in 1862, and since this period improved Ohm-meters have rendered possible the more exact measuring of that amount.

As to musical pitch, efforts are now being made to settle a universal pitch, and this, when effected, can easily be represented among other standards.

The possibilities of such a department as Standards Department of the British Board of Trade are unlimited, and as a power to reduce to order the various systems of the world its importance cannot be over-rated.

Digitized by Google

Sketch of the Geology of the Southern and Western Parts of the Lake Eyre Basin.

By Gavin Scoular, Corresponding Member.

[Read September 7th, 1886.]

Plate III.

The following notes were made in the course of a journey which I undertook in September last as far north as Anna Creek and Mount Margaret.

Geology of the Country Around Farina.—The secondary beds thin off to the south, dying out about ten miles south of the Railway Station. The higher lands in the neighbourhood are chiefly occupied with hard calcareous beds, apparently non-fossiliferous, whereas the flats, which have been denuded by Leigh's Creek, consist of a powdery gypsiferous material.

Geology of the Country passed through between Farina and Anna Creek Head Station.—For the first thirteen miles we passed over a plain of very uninteresting country to the geologist; there then appeared in the distance, to the westward, white gypsiferous cliffs, which to some degree relieved the monotonous aspect of the landscape. We shortly after entered upon the low swampy lands of Hay's Creek. After crossing it we halted on a small sandhill on the eastern side, about two miles above its junction with Leigh's Creek. Mount Nor'-West now began to loom ahead in the distance to the north-west.

By making a detour I had the opportunity of examining the *debris* of a deserted well, which had been dug in the thin covering of secondary strata which rests upon the primitive rocks a little below the crossing place, but did not find any fossils nor discover anything interesting about the material which had been taken from it. After crossing the creek we travelled upon a ledge of old primitive rocks which runs across the bed of the creek from 15 to 20 yards. No doubt these beds constitute a portion of the old slate series, which appear from beneath the cover of secondary beds far more frequently in the north country than is generally supposed. The strike of these beds is approximately north and south, and the dip is westerly.

We then ascended a slight rise, from 15 to 20 feet, on to a stony plain of secondary age that stretches away for several

Digitized by Google

miles to the north. This plain, which seemed to be almost level for a distance of about two miles after leaving the creek, begins to rise before reaching the gate leading into the sheep paddock, about one and a half miles north-east of Mandowna Railway Station. About 40 yards within this enclosure fundamental rocks of a dark purple colour appear at the surface, having a strike, as determined, of 45° west of north, and a dip of 80° westerly. From the general appearance of the country north and north-east of this place, these beds are extended much further in these directions, probably constituting the greatest part of the highlands between this point and the River Frome. Passing on in a westerly direction, the surface still rising and consisting of secondary strata, we bore straight for the eastern side of Decoy Hill, the northernmost summit of the Mount Nor'-West Range, and about four and a half miles slightly west of south from the Boorloo Springs.

On ascending Decoy Hill, I found it to consist of a very hard quartzite. I also found that on both sides of the band the material was slightly less metamorphosed, and thinly bedded, whilst the centre of the band was very hard and compact, carrying blocks of considerable thickness; strike, 50° west of north; dip, about 80° westerly; estimated thickness, about 200 feet; locality, about four and a half miles—from 20° to 30° south of west from Hergott Railway Station. The water of the largest of the Boorloo Springs possesses very nauseous properties, presumably due to salt and sulphurous ingredients. We stood by the spring and observed its motions carefully for a short time, and noticed as its waters were liberated at the surface of the pool an intermittent or an occasional puff of gas was set free, indicative that gas of some kind was generated in their passage to the surface. Besides salt and sulphurous matter, the waters of the springs must hold a considerable percentage of lime in solution; for the travertine thrown down around the outlet of the springs has already accumulated to a height of from eight to ten feet above the level of the surrounding plain. We ascended another, which is situated a short distance north-east from the main spring; also a third, which seemed to be left in its primitive state, located a few yards distant from the last, and estimated that the outflow of the two smaller ones is barely equal to the discharge of water from the main spring, though to all appearance the travertine collected around them is quite as great as the mound around the larger spring. This may indicate that they are in process of extinction, or that they have been longer in existence, if the discharge of water has been equable from their commencement. The quartzite band we had seen at Decoy Hill is continued in a northerly direction

Digitized by Google

quite as far as the Boorloo Springs, which in its course appears on the rising ground about three-quarters of a mile westerly of them. Here it has become metamorphosed into a quartz.

Leaving the Springs, we proceeded crossing a flat about three miles north-west of the Hergott Railway Station, and followed the track leading nearly west over a tableland until we abruptly descended into Collanna Creek. The eastern section at this creek has, at a distance of about seventy yards from the bed of the creek, an altitude of about one hundred feet. The lower portion of this section consists of a clayey material, with flakes of selenite scattered throughout, evidently the waste of an argillaceous bed, the upper portion consisting of variously-sized pebbles, averaging from four to nine inches in diameter. The wasting away process is here carried on more rapidly in the clayey deposits than it is in the conglomerates, hence the latter become undermined, and finally fall in large blocks, soon to become disintegrated, the pebbles getting profusely scattered over the slopes and base of the cliff. Further up the creek, but on the opposite side, there is a bluff of secondary strata, without the conglomerate cover, higher than the other including its capping of pebbles. The presence of these conglomerates imbedded on the surface of the plain at so high a level above the bed of the creek leads me to suppose that before the ravine was cut through the secondary beds, the creek emptied its waters over the plain at this place, hence the presence of boulders of a primitive type so high above the level of the modern channel.

Leaving Collanna Creek, for a short distance we passed over an undulating, or rather a knolly country, similar geologically to the foregoing, excepting that there were not so many stones of a primitive character scattered over the surface. On ascending any small height we could descry in the distance to the south hills presenting a semi-chalky aspect on their northern slopes. Coming to the Welcome Springs we found them situated in a valley about twenty feet below the level of the plain. The question arose, from whence came so large a volume of water sufficient to cut a channel deep enough to expose and liberate the waters of the various springs? A moment's reflection led me to consider that I had seen hills and tablelands to the south and south-west sufficiently high to collect and discharge from their summits flowing water, which in time may have scooped out a channel of these dimensions across the plain, and deep enough to liberate the waters of the springs. The water from the largest spring was a little more palatable than that we got at the Boorloo, though it has a peculiar sulphurous taste and smell. Travertine in large quantities has been thrown down around the two lesser springs which I examined, whilst very

Digitized by Google

little is accumulated around the outlet of the chief or great spring of the group. It is therefore my opinion that the lesser springs at some former period constituted in turn the chief spring, and that when the accumulation of travertine ascended to a height sufficient to prevent, in a great measure, the free outflow of water from them it found its escape in another place on the flat where less resistance was offered to its outflow.

Following the leading track across the plain as far as Kindeber Creek, we continued our course until we reached the Wangeyanna Springs. These springs occur in a valley or ravine very similar to the Welcome, but the outflow of water is not so great. The water, though alkaline to the taste, is far more palatable than either those at the Welcome or Boorloo. Gradually ascending we obtained a fine view of Pole Creek Range ahead. When flooded the Pole Creek must pour down enormous quantities of water on account of the large extent of highlands that are situated around its sources. The Davenport Springs, which we next reached, are distributed over the bed of the creek for the length of a quarter of a mile. Through the evaporation of their waters a goodly amount of white saline material has accumulated over the bed of the creek in the vicinity of the springs. The water of the chief spring of the group is not very palatable. It is nevertheless considered to be of fair quality for stock purposes. To the south-west of the main spring, at a distance of less than 300 yards, a bluff of fundamental rocks occurs, consisting chiefly of old, dusky, and purple-coloured slates, with a quartzite band of no great thickness interbedded, the latter giving a bold outcrop and peculiar prominence to the whole. The strike of the quartzite is 10° south of west, dip 67° westerly.

About two miles down the Davenport, on the eastern side, fossil shells of secondary age were found scattered about on the surface of a gentle rise. Indeed, it seems that wherever the argillo-calcareous prominences occur fossils may be found. As we passed to the north-east of the Finniss old head-station we came upon drift and numerous sandhills. To fully account for the drift sand, the country must have been partially covered with desert sandstone after the secondary marine strata were deposited. The winds and waste of centuries have perfectly disintegrated the once consolidated eolian deposits, and, so far as can be observed, no remains of the solid parts of the formation now exist in the neighbourhood.

On the western side of the creek, near Humphrey's Springs, several of the argillo-calcareous knolls occur, with abundance of fossil shells belonging to various species. This is the most prolific spot I have seen in the north for fossil shells. A few paces north-easterly from these low hills or knolls, on the south-western

Digitized by Google

side of the creek, a section of the secondary strata is exposed from eight to ten feet in height. Although in close proximity to the knoll which yielded the greatest variety of fossil species, none were discovered in the face of this section. The lower portion of the section consists chiefly of soft clayey material, whilst the upper beds are composed of much harder rock.

Quitting this place, and following the bed of the stream about fifty yards to the north-east, I discovered a band of old rocks running across the bed of the creek, the strike of which was found to be 10° north of west, dip 45° to the south. A reversal in the dip of the primitive beds between here and the Davenport Springs can only be accounted for by the fact that the Humphrey's Springs beds are situated further to the north-east in the old series of beds than those occurring at the Davenport Springs with an anticline intervening, causing the alteration of dip between the two places. From the large amount of saline matter deposited over the bed of the creek, it might be considered that the waters from the springs would be far less palatable than they are.

After leaving the springs we crossed to the northern side of the Gregory, from which position we could look back and see the hill of primitive rocks, which constitute the range south-west of the Davenport Springs, dipping under the secondary beds to the north-west. The Priscilla Springs were next reached. Here a considerable quantity of mineral incrustations is spread over the bed of the creek, caused by the evaporation of the waters from the springs, around which sand and sandhills abound. The flow of water is not great, but is very fair in quality. We passed within a mile of Lake Phibs, the waters of which, I was informed, are very salt, and that in the centre of the lake there is an island with a spring of very salt water upon it. We crossed Stuart's Creek a little above the highway crossing, the north-western bank of which rises in places from eight to ten feet high. I had been informed that fossils were to be found here, but although I looked carefully for such I observed none. The non-fossiliferous character of the deposits at this place does not by any means imply a similar absence of fossil remains further up the creek.

Passing Stuart's Creek we crossed the Margaret River, and afterwards came upon more knolls containing fossils. For several days from this point we passed over a succession of arid plains almost bare of vegetation, making a detour of about two miles in a more westerly direction by the Mount Hamilton cattle yards, after which we crossed a creek and passed over a very stony plain to the Warburton Springs, from the chief of which a considerable volume of water flows, but soon disappears through evaporation and absorption, not reaching beyond the

Digitized by Google

bare claypan, which is now covered to dazzling whiteness for an area of several hundred acres with an incrustation of salts. The water, however, was of fair quality.

On the following morning I examined the two smaller springs that are situated north of the Beresford or Trig. Hill, and found the waters much similar in taste to those of the Warburton, or chief spring of the group. From the height the travertine has attained around these springs, and the comparative smallness of the volume of water issuing therefrom, it appears to me that at some former period in their history these two springs were the main outlet to the water which now flows from the chief spring in large volumes. The travertine around the lesser springs is about fifty feet in height, and the reason why their waters have now become languid in their outflow may be on account of the greater distance they have to rise before reaching the surface, whilst the greater outflow of water at present from the much lower situated spring, south of the Beresford Hill, may arise simply from the difference of level at their exit.

The most interesting section of the secondary strata I met with in my travels in the north was obtained in connection with the Beresford Hill, but for various reasons it did not get the thorough inspection from me it otherwise should have got. From the imperfect view I obtained of it I saw that the beds constituting the upper portion of the hill, though seemingly perfectly horizontal, were much harder in texture than those forming the lower parts.

The Strangways Springs are a remarkable group, amounting in all, I was told, to about 400. I observed whilst some had a considerable volume of water, others seemed to have about attained their maximum height of travertine, and consequently discharged their waters more slowly; while others, again, seemed to be completely choked up through the accumulations of travertine that had collected around their outlets. The travertines from these waters consist chiefly of carbonate of lime, a little soda, and sulphurous matter, and in many cases a considerable percentage of ferruginous matter. I also observed, in several cases, that these mounds of travertine have been apparently acted upon by internal forces. Mr. Warren, sen., of Springfield, informs me that not unfrequently strange sounds have been heard about the Strangways, as if the pent-up gases in the water below were escaping upwards and exploding on reaching the surface, and he attributes to this cause the present shattered-like appearance many of the mounds present. In support of this theory he stated that one night a peculiar rumbling sound was heard in the neighbourhood of Finniss Springs, and on the following morning water was found to be

Digitized by Google

issuing from a place it had never been known to issue from before, and is still continuing to do so.

On leaving Strangways Springs we crossed the Warrenei Creek, and for miles afterwards there is nothing seen but a country bestudded with sandhills and claypans alternately—the latter being the bared portions of the secondary strata, the former the reconstruction of the desert sandstone, the prevailing winds having so arranged the sandy materials resting on the impervious clays of the secondary era into the features of sandhill and claypan, which may be said to culminate at the Yellow Waterhole Lake. This lake or waterhole is exceedingly uniform in depth throughout, and cannot contain a less area than sixty acres. Its entire surface is covered with a species of water-grass, which stands from four to five feet in height. This grass was nearly ripe at the time we were there, and the horses seemed exceedingly fond of it. Although fresh, the waters of the lake were thick with clayey and other matter in suspension. The sand-dunes, which must on an average stand about twenty feet high (contrary to natural order), seem to encircle this lake. For a considerable distance from the lake we travelled over a very similar country to that we had passed over the day before. At length we emerged upon an open plain, and the fossiliferous nodules, which we had not seen for some time, began to occur again.

Pursuing our course along the plain we arrived at the Emily Spring. A salt swamp intervenes between this spring and the William Spring, the two being situated about a mile apart—the former on the southern side of the incrusted claypan, and the latter on the northern. Neither of these springs have mounds rising more than three feet above the level of the surrounding plain, and from appearances are not likely ever to attain a much greater height. The water from the Emily Spring, though not abundant, is very fair in quality.

Next morning I visited the borehole on Anna Creek, the road being over sandhill country a considerable part of the distance. The country about the borehole, and for a considerable distance towards the Emily and William Springs, is evidently covered with the waste of the desert sandstone, as the well-sinkings immediately north of this place fully prove. Mr. John Hogarth, of the station, informs me that the kitchen well was the first he sank in this group, and that the first eighteen feet was through sand and clay, at which depth salt water was obtained. At a depth of thirty feet from the surface the blue clays of the secondary period were struck. At a total depth of seventy feet from the surface a plentiful supply of very fair household water was obtained, which rises in the shaft to within fifteen feet of the surface. During the shearing

Digitized by Google

season the draw upon this well cannot be less than 4,000 gallons daily, and that amount never lowers the water in the shaft more than about four feet.

About half a mile down the creek, and from ten to fourteen feet below the level of the kitchen well, the boreholes of the wool-washing establishments are situated. These two boreholes yield almost an unlimited supply of rather better water than the kitchen well does. In both cases the superficial spring of salt water was struck at a depth of from ten to fourteen feet from the surface, which was dammed back in the usual way by inserting piping in the borehole. One of these boreholes is only seventy-five feet in depth. The other, though yielding a large flow of water, was continued to a depth of 160 feet, in hope of increasing the supply, but in both cases the water rises to within eighteen inches or two feet of the surface. The deeper one yields a little more than the other, but the slight increase bears no proportion to the extra depth.

The blue secondary clays, which underlie a covering of sand from 20 to 30 feet in thickness at the borehole, occupy the surface of the country a mile or so before reaching the creek about six miles north of the William Spring. How far this formation extends from the boreholes in a north-westerly direction beneath the sandhills it is impossible at present to say. This much, however, with confidence may be said, that these clays stretch all the way beneath the sandhills across the country from the boreholes past the William and Emily Springs southward as far as Warrenei Creek near the Strangways Springs. Their north-westerly limits cannot, however, extend further than the site of the Moorumbuma Well, for in that sinking they are not represented, neither are they in the well at Anna Creek Head Station.

I also visited the flat, some nine miles distant, in which the Moorumbuma Well is situated. In this well the desert sandstone is the water-bearing stratum. The beds penetrated in this sinking are as follows:—A surface stratum of sandy clay. Beneath this clay the desert sandstone occurs, in which water was obtained at a depth of 63 feet, and at a total depth from the surface of 82 feet a copious supply of excellent stock water was obtained. It is possible that the blue clays at the secondary era may underlie the desert sandstone at this spot, but I scarcely think so, on account of the great thickness of the formation and the plenteous supply of water it produces. This well and all others whose waters are obtained in the desert sandstone seem never to rise in the shaft above the level at which they are first obtained. This peculiarity leads me to infer that waters with this feature are all of local origin.

After crossing Moorumbuma flat we ascended a large sand-

Digitized by Google

hill, from the top of which we could see the head station, situated on a gentle rise about half a mile before us, at which place we had not well arrived when rain began to fall, and though about quarter of an inch fell during the night, by 8 o'clock next morning scarcely a vestige of it was to be seen upon the surface.

For a distance of about two and a-half miles up from the head station on either side of Anna Creek the country continues to be of a sandhill character. To the south-west and west of Milcheterrana Hill it is studded over with gentle rises belonging to the Primary series. To the east of that hill, however, and for about a mile south-east on the eastern side of the creek a sandy plain stretches away for several miles in that direction. This plain is also here and there interrupted with bluffs of old rocks. Close to the creek and about three miles above the head station there is a band of very hard quartzite standing about eight feet above the level of the present surface; strike, 10° west of north; dip, about 10° easterly; thickness, about 16 feet. Fundamental slate rock also appears at the surface in *situ* at this place on the eastern side of the quartzite. The band, which here rises above the plain as a mere bluff, on pursuing its course northward constitutes the summit of Milcheterrana Hill. Directing our path a little more west from here, and at a distance of about a quarter of a mile, a band of blue marble was observed, which makes (as Mr. Hogarth informs me) most excellent mortar. Strike of this marble band, which is exposed at the surface for at least one hundred yards north, is about magnetic north and south, dip 60° east. The quartzite band, referred to above, constitutes the summit of the hill, from 130 to 140 yards to the east of the marble one. Between it and the quartzite, however, about one-third of the distance is occupied with marbles much more argillaceous in quality. On the western side of the pure marble band, which at this place is not more than two feet in thickness, a band of gritty quartzite is interbedded, the strike and dip of which are the same as that of the marble band.

The Anna Creek head-station and well are situated in lat. 28° 60′ south, long. 136° 8′ east. The well yields an inexhaustible supply of most excellent water. The strata penetrated consist, in descending order, of twenty-five feet of sandy clay, thirty-eight feet of desert sandstone, at which depth water was struck. The sinking was continued four feet further, making a total depth of sixty-seven feet. The stratum in which water was first discovered consisted chiefly of a gypsiferous clay. The daily quantity of water which the well produces has never been fully ascertained, but taking from it at the rate of 1,000 gallons an hour lowers the water in the shaft

Digitized by Google

one foot, but beyond that depth, although the quantity extracted be greatly increased, no further impression can be made upon the supply.

Tom's Well, which is also in the desert sandstone, is situated on a flat among sandhills about ten miles in a southerly direction from the head-station. The section of strata passed through in descending order was twenty-three feet through sand and clay, forty feet of desert sandstone, at which depth water was obtained. A thin bed of ferruginous conglomerate was afterwards pierced, from which the greatest amount of water flowed. This water, though of fair quality for stock, is rather salt for domestic purposes.

The Deep Well is situated about five miles from the preceding one, on a flat among sandhills about twelve miles south of the head-station, and about five miles distant in a north-westerly direction from Tom's Well. This well penetrates the desert sandstone 125 feet; its waters are much the saltest of any I have tasted in these parts of the north. A nodule of galena was taken from the sandstone beds whilst the well was in process of sinking. A borehole in progress some five to six miles above the William Spring was visited, and some of the clay which I secured from this sinking has been examined by Mr. Howchin, F.G.S., and has yielded some very interesting microscopic forms, particulars of which I append to this paper. Near this place I saw the spot where the fossil wood brought down by me had been taken from. I also satisfied myself on this occasion that the secondary strata, though obscured in the greater part of the distance with sandhills, are continued beneath them uninterruptedly from the borehole to William Creek.

My next geological tour was north as far as Mount Margaret. From the head station the first three or four miles of the journey the surface of the country consists either of loose sand or old rocks. In the middle of the plain—about four miles from the head station—the latter appear on the surface as a quartzite. The strike of these beds is about north and south; dip, east. These quartzites constitute a slight rise for a considerable distance north, and in one place showed in a hill of much greater size. On the southern slopes of this nameless hill the William Creek takes its rise in primary strata, but the mesozoic strata put on long before the creek reaches so far south as the William Spring. It would appear that the desert sandstone is continued as far east as this hill, for about four miles south-south-west from it water was found in a well penetrating that rock. From the summit of the hill just referred to we gradually descended to the Douglass, passing chiefly over sandy country. Before we reached the bed of the stream we came upon a patch of rock, overlying the old beds,

Digitized by Google

which closely resembles the Upland Miocene arenaceous beds of Munno Para East and the surrounding neighbourhood.

The Douglass Well, which is sunk in fundamental rocks, only yields about 1,000 gallons of water daily; it is about 60 feet in depth to the water-line, of which about fifteen feet is surface material, the remainder passing through old slate rock. At this depth a scanty supply of excellent fresh water was struck, which was slightly increased by sinking about ten feet further. At a total depth of 70 feet a bed of very hard and dry slate was struck. Driving was then resorted to in the hope of finding a better supply, but that, too, failed, and the enterprise was abandoned. Following the dry channel which runs nearly in a south-east by east direction from the well, I came to a bold bluff of very hard quartzite projecting about 20 feet above the general level of the country. The strike of this bed is 20° east of north; dip, 25° easterly. Looking down the dry channel into the Douglass gorge and at about three-quarters of a mile distant from this place, on the north-north-east side of the channel, another and a more prominent bluff of quartzite was displayed. As near as could be ascertained the strike of the beds is 10° west of north; dip, 45° easterly; height above the general level of the plain, about 50 feet. For a considerable distance up the stream, on the north-eastern side, seemingly nothing but felspar is exposed to view.

The track we then followed led in a north-north-easterly direction, and over country showing primary rocks. Nothing, however, of a very striking nature was observed, unless it was the occurrence of a patch or two of arenaceous beds similar to those we discovered on the western side of the Douglass. On reaching the Blackfellows' Quarry, which is between three and four miles from where we started in the morning, I noticed that the stone exposed to view is a gritty fissile quartzite, and must have been worked by the aborigines from time immemorial, judging from the size of the excavation, which extends along the strike of the beds a distance of from fifty to sixty yards, the depth of which in several places is not less than from ten to twelve feet. The strike of these beds is 10° south of east, dip 45° northerly. From the quarry referred to the country declines for about a mile and a half into the bed of Sunny Creek, after which a gentle rise occurs, when suddenly the surface aspect of the country is changed from that of a sandy nature to one literally covered over with ferro-arenaceous boulders and nodules of every fanciful shape and form. This character of surface is maintained for a distance of from half to three-quarters of a mile, when the track rapidly begins to fall to the level of the plain below. Yet the potstones and catheads of ferro-arenaceous material are scat-

Digitized by Google

tered over the surface as profusely as ever, and continue to be so until the bottom of the declivity is reached, which cannot be less than forty feet below the level of the upper plain. Afterwards a stratum of loose sand, varying in depth, takes the place of these ferro-arenaceous nodules all the way to the crossing at Davenport Creek. On the south-western side we examined a hill which was one of the many remnants of an extensive bed of Desert Sandstone, which at some former period had been deposited against the old rocks that lie to the south-west. We afterwards found the same formation had at one time overlapped the secondary strata to the north-east. From the uneven manner in which decay seems to be acting upon the formation, and the peculiar structure its bedding presents, there can be little doubt that the formation was of eolian origin, and that the deposits, of which these stacks now form but small and isolated remnants, were originally formed by being blown by the winds against the sheltered and upstanding edges of the primitive rocks.

About half a mile before reaching the crossing at Davenport Creek we observed a conical hill of old rocks situated on the eastern side, and at a distance of from 400 to 500 yards from the track, which cannot be less than 50 feet above the level of the surrounding plain.

On arriving at the bed of the creek we found by recent flood-marks that this creek when flooded carries quite as much water, if not more, than the Douglass. We also observed that the gumtrees are more numerous along its margins, and although somewhat stunted and gnarled in appearance they are also much taller than at the Douglass. Mulga and other lesser shrubs seem to thrive tolerably well on the flats around its banks. Crossing the Davenport Creek we soon found ourselves treading again on the blue clays of the secondary era, which here overlie for several miles to the west the rocks of primitive age, forming, as it were, the inside half of a rude parallelogram against the old rocks of the Mount Margaret Range on the west and those of the Douglass and Blackfellows' Quarry country on the south.

The rocks constituting the eastern side of Mount Margaret Range have a strike of about 30° west of north, and the trend of the range itself is nearly north and south. After crossing Hope Creek and approaching nearer the range we began distinctly to observe the outcrop of the harder beds as they showed in bold relief along the mountain side, presenting a most magnificent aspect under the rays of a declining sun. On arrival at the spring at the cattle yard we found the streams from the detached hills to the west had cut a gorge through the eastern side of the range immediately south of the spring,

Digitized by Google

extending for quite a mile across the mesozoic deposits. This channel is about ten feet deep near the junction of the old and new beds, and therefore I fully expected to find fossils of some kind or other, but so far as I could discover the beds were non-fossiliferous. From the top of the nearest peak we obtained a very fine view of the detached hills constituting the western part of the range, and also of the vast plain stretching easterly. As far as the eye could reach to the west nothing but hill beyond hill was to be seen presenting their weathered and shivered peaks to the setting sun; whilst to the east the view before us was a vast plain of unusual sterility, composed of secondary strata. The strike of the primitive rocks was found to be 30° west of south and east of north; dip, 65° westerly; estimated height above the level of the eastern plain, about 200 feet. The spring, which by no means can be called a strong one, wells out at the junction of a band of marble or primitive limestone, where the old beds join the new. A considerable amount of calcareous material (travertine) has been deposited around the spring at a former period. The water, though slightly tainted with mineral ingredients, is, nevertheless, very good drinking water.

I ascended another of the eastern peaks of the Mount Margaret Range, which stands about 25 feet higher, and situated about half a mile north of the one we had previously ascended. From the difference between the trend of the range and the strike of the strata the material of which this peak is composed is entirely covered with secondary beds ere they reach so far south as the spring, and I also observed that the rocks were becoming more gritty in character. I ascended another peak situated about a quarter of a mile further north, and found it composed of rocks still more gritty and harder than the summit I had left. From the top of this peak an excellent view of the surrounding country was obtained, and the bearings I found much similar to those we had taken the previous night. Following up the creek in the neighbourhood I came upon a stratum of the prevailing quartzite, metamorphosed so highly as to present the appearance of a quartz rock.

Analyses of Samples of Water.

Several samples of water taken from the springs mentioned in this paper were submitted for analysis to Mr. A. Thomas, F.C.S., analytical chemist, with the following results. All the wells referred to except one (Mount Margaret Spring) are situated on Messrs. Hogarth & Warren's run:—

Digitized by Google

Deep Well.

Solids per Imperial gallon, 10·60 grains, consisting of—

Sodium chloride	8·10
Sulphuric acid	1·03
Iron and alumina	·05
Lime	·89
Magnesia	·44
	10·51

Mount Margaret Spring.

Solids per Imperial gallon, 2·06 grains, consisting of—

Sodium chloride	1·24
Sulphuric acid	·34
Iron and alumina	·03
Lime	·52
Magnesia	·36
	2·19

Douglass Well.

Solids per Imperial gallon, 0·80 grains, consisting of—

Sodium chloride	·40
Sulphuric acid	·12
Iron and alumina	·08
Lime	·08
Magnesia	·06
	0·74

Wool-wash Borehole.

Solids per Imperial gallon, 5·00 grains, consisting of—

Sodium chloride	4·12
Sulphuric acid	·39
Iron and alumina	·02
Lime	·32
Magnesia	·29
	5·14

Kitchen Bore Hole.

Solids per Imperial gallon, 5·70 grains, consisting of—

Sodium chloride	4·12
Sulphuric acid	·20
Iron and alumina	·04
Lime	·70
Magnesia	·14
	5·50

Digitized by Google

PLATE 8.

GEOLOGICAL SKETCH MAP OF LAKE EYRE BASIN

at
er-

ar
ut
ns
es.
ed

an
T.

ial
ro-
ed

ive

Digitized by Google

Digitized by Google

Anna Creek Well.

Solids per Imperial gallon, 0·54 grains, consisting of—

Sodium chloride	0·20
Sulphuric acid	·17
Iron, clay, and magnesia	·10
	0.47

Tom's Well.

Solids per Imperial gallon, 10·70 grains, consisting of—

Sodium chloride	1·56
Sulphuric acid	1·03
Iron and alumina	·10
Lime	5·24
Magnesia	2·56
	10·49

PALÆONTOLOGY.

LIST OF FOSSIL MOLLUSCA collected by Mr. Scoular at Davenport and Humphrey Springs, Central Australia, determined by Prof. R. Tate:—

Belemnites australis, *Phillips (?)*. Fragments only.
Monotis Barklyi, *Moore*.
Modiola linguloides, *Huddleston*.
Modiola Scoulari, spec. nov. An ovately reniform shell similar to M. imbricata, *Sowerby*, of the English Jurassic rocks, but a little less curved ventrally and with strong corrugations in the umbonal region; length 65, breadth 32 millimetres.
Modiola sp. A cast only. Lanceolate with much produced anterior side.
Trigonia sp. Casts only. A trigonal form, a little longer than broad; certainly neither T. mesembria, *T. Woods*, nor T. nasuta, *Etheridge*.
Arcomya sp. Cast.
Pleuromya sp. Cast.
Cytherea (?) Clarkei, *Moore*.
Cypricardia sp. Cast.

LIST OF FOSSIL MICROZOA.—A small quantity of material from William Well, Lake Eyre district, was subjected to microscopical examination by Mr. Walter Howchin, who has supplied the following particulars:—

The Microzoa consist chiefly of Foraminifera, of which five species were noticed, viz.—

1. Cristellaria gibba, *d'Orbigny*.
2. Marginulina glabra, *d'Orbigny*.
3. Vaginulina legumen, *Linné*.
4. Nodosaria radicula, *Linné*.
5. Haplophagmium sp. (a single example much distorted).

Digitized by Google

All the above are known as fossil forms in British Palæontology. No 1 dates from Cretaceous times, No. 2 from the Lias, No. 3 from the Trias, and No. 4 from the Permian.

The geological material resembles that passed through in the Hergott borings, and all the foraminifera noted above were obtained in the Hergott material. There is therefore little doubt that Mr. Scoular's gatherings belong to the same geological formation.

The fossils other than foraminifera observed in the material under notice were a single carapace of an Entomostracan and some fragments of vegetable tissue. A few minute pyritous casts also indicate the existence of vegetable life.

Digitized by Google

Additions to the Extra-Tropical Flora of South Australia.

By Baron F. von Mueller, K.C.M.G., F.R.S. &c.

[Read September 7, 1886.]

Capparis spinosa. Near the Finke River. *Lieut. Dittrich.*
Tribulus macrocarpus. Near Charlotte Waters. *Rev. H. Kempe.*
Sida platycalyx. Near Charlotte Waters. *Rev. H. Kempe.*
Phyllanthus thesioides. Near Charlotte Waters. *Rev. H. Kempe.*
Casuarina humilis. Eucla. *Bate.*
Portulaca australis. Near Finke River. *Lieut. Dittrich.*
Dodonæa tenuifolia. Near Spencer Gulf. *Prof. Tate.*
Gomphrena Brownii. Finke River. *Kempe.*
Bassia Cornishiana. Near the Queensland Boundary. *Cornish.*
Pultenæa scabra. Kangaroo Island. *Tepper.*
Crotalaria Mitchelli. Spencer Gulf. *Prof. Tate.*
Ptychosema trifoliolatum. Near McDonnell Range. *Kempe.*
Neptunia monosperma. Near McDonnell Range.
Acacia stipuligera. Near McDonnell Ranges. *Giles.*
Acacia Spilleriana, *J. E. Brown.* Wirrabara, Clare &c. *Brown.*
Acacia Whanii. Near the Murray River.
Acacia gonophylla. Near Eucla. *Bate.*
Acacia iteaphylla. Spencer Gulf. *F. v. M.*
Rotala diandra. Near MacDonnell Ranges. *Dittrich.*
Melaleuca quadrifaria. Near Eucla. *Bate.*
Eucalyptus Oldfieldii, *F. v. M.* McDonnell Range. *Schwarz.*
Hydrocotyle pterocarpa. Near Glenelg River. *Mrs. Dr. Wehl.*
Actinotus Schwarzii, *F. v. M.* McDonnell Range. *Schwarz.*
Spermacoce marginata. Near the Queensland Boundary. *Cornish.*
Pluchea tetranthera. Near McDonnell Range. *Kempe.*
Gnaphalium Indicum. Finke River. *Kempe.*
Calogyne Berardiana. Near Charlotte Waters. *Kempe.*
Goodenia Strangfordii. Near McDonnell Range. *Kempe.*
Cuscuta Tasmanica. Murray River.

Digitized by Google

Peplidium humifusum. Near Charlotte Waters. *Kempe.*
Utricularia lateriflora. Near Glenelg River. *F. v. M.*
Eremophila denticulata. Near Eucla. *Bate.*
Acianthus caudatus. Kangaroo Island. *Tepper.*
Crinum angustifolium. Near McDonnell Range.
Triodia Mitchelli. Near McDonnell Range.
Nitella microphylla, *Al. Braun*—named by Dr. Nordstedt. Onkaparinga River. *Tepper.*
Cladophora crispata. St. Vincent Gulf. *Tepper.*
Physcomitrium repens, *C. Mueller.* Spencer Gulf.

Description of a New Corchorus from Central Australia.

By Baron von Mueller, K.C.M.G., M. & Ph.D., F.R.S.

[Read September 7, 1886.]

Corchorus Elderi.

Somewhat shrubby, upright, much branched, thinly starry-tomentose; leaves small, almost oblong, or some merging into an ovate form, crenate-serrulated, above soon glabrescent; flowers minute; peduncles usually very short or obliterated; pedicels one—three, soon longer than the flowers, scantily star-hairy; calyx while unexpanded nearly globular; petals hardly exceeding the calyx; stamens twenty or fewer; style extremely short; fruit small, ovate-globular, four—five-valved, outside densely setular-and starry-tomentose; seeds five—three or rarely two—one in each cell.

In the region north of MacDonnell Range, found by Lieut. Dittrich during Mr. Lindsay's expedition.

Habit not unlike that of *C. hirsutus;* height, one—two feet; leaves short-stalked, half—one inch long, somewhat crisped; stipules and bracts wiry, short, setaceous-linear; peduncles occasionally lengthening to half an inch; flowers only one-sixth or one-fifth inch long; calyx deciduous, slit in its upper

Digitized by Google

part only, unless finally deeper; petals pale-yellow, glabrous, orbicular-ovate, not distinctly gland-bearing, though slightly thickened at the base; anthers cordate- or globular-ovate; style glabrous; fruit-bearing pedicels one-third to half-inch long; torus extremely short; disc spreading, membranous, undulating, glabrous; well-developed fruits one-third inch long, but not rarely smaller and also then maturing; its vestiture greyish and remarkably dense, consisting of star-hairy minute setules; valves inside glabrous and shining; septum of each valve straight and firm; descendingly tranverse, slight elevations between the seeds, but no distinct septules; seeds about one-twelfth inch long, oblique- or truncate-ellipsoid, smooth, brown-black outside and not shining.

This species is nearest allied to *C. sidoides*, but very different in its fruit, standing as regards the main characteristics of the latter quite alone; some affinity of our new plants to *C. echinatus* is also obvious, but that species is rendered by the septicidal dehiscence of its fruit-capsule somewhat anomalous in the genus *Corchorus* and verges much towards *Triumfetta*. Indeed, for limiting these two genera we can best rely on the structure of their fruits, and if from that the main distinctions are to be derived then *T. pilosa* among Australian species, as well as some African and other congeners, would need to be transferred from *Triumfetta* to *Corchorus*, as to some extent pointed out already in 1863 (Fragm. Phytogr. Austr. IV., 29).

In bestowing on so humble a plant the name of Sir Thomas Elder, I should remark, that this floral novelty is the most interesting gained during the expedition, which through the special aid of this munificent promoter of all interests of South Australia has been enabled to shed additional light also on the Central Australian flora.

Digitized by Google

Diagnosis of a New Species of Caladenia.

By Professor Ralph Tate, F.L.S., F.G.S., &c.

[Read October 5, 1886.]

Plate II.

Caladenia cardiochila.

A slender hairy species from six to nine inches high; one-, rarely two-fld. Leaf linear lanceolate, sheathing at the base, from two to three inches long.

Sepals and petals brownish-red with a yellow margin, or yellowish with a brownish-red streak down the centre; linear-lanceolate, neither contracted nor clavate, and quite free of glandular pubescence. Dorsal sepal erect, incurved over the column; narrower than the lateral sepals, which are flat, lanceolate, dilated upwards, abruptly acuminate, and about 17 millimetres long by 4·5 broad. Petals linear, 17 millimetres long by two broad. Labellum on a long claw, undivided, margin entire, cordately ovate, somewhat flat, but not recurved, contracted towards the tip where the margin is thickened, and of a dark red-brown colour. The colour of the labellum is yellowish above and below, with a reddish margin, and streaked dichotomously on the upper side, and blotched on the wedge-shaped tip with the same colour. Length, ten millimetres; breadth, eleven mills. Calli in two rows, large, elevated, closely packed, oblong, attenuated at the base and graduating into linear-clavate at the base of the labellum, of a very dark red-brown colour. The anterior third of the labellum is naked. Column much curved, broadly winged in the upper two-thirds, mottled with brownish-red. Anther with a short acute point. Two oval calli at the base of the column.

Sandy ground under the shade of Casuarinas and Eucalypts, Golden Grove. Collected by various members of the Field Naturalists' Club, October 2, 1886. Barabba Scrub, Hundred Grace, S. Dixon (!), 1865.

This species is conspicuous amongst congeners associated with it by its broad labellum and short petals and sepals. The accompanying species were *C. dilatata*, R. Brown, *C. leptochila*, Fitzgerald, *C. carnea*, R. Br., and *C. latifolia*, R. Brown. From *C. dilatata* and its allies it is at once separable by its short sepal points, in which respect it approaches *C. Cairnsiana*, F. v. M. Its nearest ally is *C. tessellata*, Fitzgerald,

Digitized by Google

Digitized by Google

2

1.

5

4

3

W.J.CHIDLEY. DEL.

Digitized by Google

agreeing with it in its short non-clavate sepals and petals, and its flattish labellum, from which it differs by the calli being in two rows, not continued to the point of the labellum, and by their shape, also by the simple margin to the labellum, and by its broadly ovate outline.

A few years ago Mr. R. Fitzgerald personally explored the neighbourhood of Adelaide in search of orchids, and with the result that six species previously undescribed were made scientifically known. Of these there are two Caladenias—*C. leptochila* and *C. reticulata*—both of which have sepals with long points, clavate, and glandular; and are therefore only distantly related to the species herein described. The former is easily recognisable by its narrow-oblong labellum; the latter, which externally resembles *C. dilatata*, has the labellum less deeply cut, and reticulated with raised veins (as in the section *Phlebochilus*, Benth., to which *C. Cairnsiana* belongs).

EXPLANATION OF PLATE II.

1. Side view of the whole plant; nat. size.
2. Flower seen from the front; slightly enlarged.
3, Lateral sepal; 4, Petal; 5, Labellum. All enlarged two diameters.

Digitized by Google

Descriptions of some New Species of South Australian Marine and Fresh-water Mollusca.

By Professor Ralph Tate, F.L.S., F.G.S., &c.

[Read October 5, 1886.]

Plates IV. and V.

Helix reteporoides, *spec. nov.* Plate v., figs. 14 *a—c.*

Shell rather widely umbilicated, depressed, orbicular, thin; spire a little elevated; whorls five, convex, separated by a deeply-impressed or channelled suture; last whorl rounded, not descending in front, base convex; aperture slightly oblique to the vertical axis, subcircular; peristome simple, its margins disunited; columella slightly reflected over the umbilicus, which is wide and perspective. The ornament consists of regular, crowded, thin, elevated, equal ridges, and transverse, equidistant microscopic striæ in the intercostal furrows; the ridges are more distant on the spire whorls than on the last whorl; the transverse striæ are more conspicuous on the base, and the distance between them about equals the width of the interstitial grooves. Colour of shell reddish-brown.

Dimensions.—Major and minor diameters, 7 and 6·25; height, 4; diameter of umbilicus, 1·5 millimetres.

Localities.—Black Hill, near Adelaide, under rotten stumps of the "grass-tree"; under stones at the foot of the cliffs at the junction of the River Para and Jacobs' Creek; slopes of Kaiserstuhl, Barossa Range; in the stringybark forests about Clare and Penwortham.

This species belongs to a group of small shells, more or less depressed, and ornamented with raised lamellæ, represented by many species in Tasmania, with most of which I have compared it, and by three described species in South Australia, but two or more species yet remain undiagnostically known. As implied by the specific name, the shell above described has affinity with *H. retepora* (Cox), inhabiting the Flinders Range (*Masters*) and at *Port Lincoln* (*R. T.*); the general shape is the same, but in *H. reteporoides* the spire is not quite so elevated, the whorls more rotund, deeper suture, more convex base, larger umbilicus, the costal lamellæ equal and very much more numerous, and the transverse striæ finer.

Digitized by Google

Helix Tomsetti, *spec. nov.* **Plate v., figs. 13*a*—*c*.**

Shell conoidly depressed, rather thin, widely and deeply umbilicated; spire slightly elevated, widely conical, obtuse; whorls five, flatly convex, narrowly concavely depressed near the anterior suture, and margined at the suture; last whorl rounded, rather depressed above, and bluntly angled at the periphery; posterior to the angulation at the periphery the surface is slightly depressed, thence convex to the suture; base rather abruptly convex; aperture not descending in front, oblique to the vertical axis, rotundately lunate; peristome simple, thin, disunited; columella very slightly reflected over the umbilicus.

The ornamentation consists of coarse, irregular, oblique striations and distant granulations; the one and a half apical whorls granulose only; under surface striated. Colour of the living shell unknown.

Dimensions.—Major and minor diameters, 14·5 and 12·5; height, 7; height of aperture, 6; diameter of umbilicus, 2·5 millimetres.

Locality.—Cape Borda, Kangaroo Island, *(Tomsett!)*. This new species is somewhat intermediate between *H. Bordaensis* and *H. Evandaleana*, having more the shape of the former, but with the sculpture of the latter; it is flatter and has a larger umbilicus than *H. Evandaleana*.

Mitra pellucida, *spec. nov.* **Plate iv., fig. 13.**

Shell minute, slender, fusiform, translucent, colourless, polished; apex obtuse; whorls 6, flatly convex, suture distinct; the two or three apical whorls smooth, the rest with thick depressed axial costæ, the interstices linear and puncturated; last whorl lirate at the base; anterior portion of the columella slightly recurved; columella with three strong oblique plaits; outer lip not thickened, smooth within.

Dimensions.—Total length, 7·25; of aperture, 3·25; breadth of last whorl, two millimetres.

Localities.—In beach sand, Fowler and Streaky Bays in the Great Australian Bight.

This new species may perhaps belong to the section Mitroidea, it is certainly not the young of any known Mitridæ inhabiting South Australian waters, and I cannot attach it to any figured species of the family.

Paludina lirata, *spec. nov.* **Plate iv., figs. 6*a*—*b*.**

Shell subglobose, thick, imperforate; spire depressed, conic, obtuse, eroded at the apex; suture much impressed. Whorls four, convex, somewhat flattened posteriorly. Aperture oblique, large, semicircular; outer lip attenuated and acute; interior bluish-white; epidermis of an olive-green colour;

Digitized by Google

surface ornamented with longitudinal liræ and faint striæ, and obliquely transverse striæ and wrinkles of growth. There are six or seven prominent liræ on the penultimate whorl with a finer one occasionally interposed between them. On the last whorl the liræ in front of the periphery are less pronounced. Operculum horny, concentric, with the nucleus nearer the columella margin. The embryonic shells are diaphanous, pale-green, carinated on the periphery of the last whorl, on the posterior part of which are interstitial striæ between the liræ; the base is strongly striated; the nuclear whorls are depressed faintly striated longitudinally; there is no umbilicus.

The animal is oviviparous, so also is *P. sublineata*, *P. Hanleyi*, *Melania Tatei* and *M. Balonnensis*, giving birth to six to eight embryos of about three millimetres diameter.

Dimensions.—Total length, 18; greatest width, 18; height of aperture, 13; width of aperture, 10.

Locality.—Cooper's Creek at Innamincka, Central Australia, (*Mr. James McLeod!*).

The species is quite unique among Australian congeners.

Aspergillum multangulare, *spec. nov.* Plate iv., figs. 4*a*—*b*.

Disk roundly oblong, laterally sub-compressed, ventral and anterior sides prolonged into two rows of longish tubes; particles of coarse sand or shell are usually agglutinated to the disk, or it is adherent by one valve.

Valves oblong, inequilateral, translucent; umbones anterior, prominent; surface with distant concentric growth-folds, and rayed with microscopic lines.

Tube short, straight, or slightly bent, rather constricted at the proximal end; octagonal, obtuse, not keeled at the angles; transversely irregularly striate.

Dimensions.—*Disk*, antero-posterior diameter, 8; umbo-ventral, 5; sectional diameter, 3·5. *Tube*, length, 6; diameter, 3 millimetres.

Locality.—Not unfrequently cast up on the sandbeach of Holdfast Bay, St. Vincent Gulf.

This species belongs to the section of the genus corresponding with *Humphreyia* of Gray, which includes two other species only, both Australian; from those it differs conspicuously by its small size and many-angled tube.

Hemimactra versicolor, *spec. nov.* Plate iv., figs. 12*a*—*b*.

Shell cuneiformly ovate, solid, equivalve, very inequilateral, moderately convex; colour, white, yellowish, brown, purplish, bluish-white; shining, ornamented with rather fine growth ridges; umbos distinct, incurved, approximate; anterior side very short, its margin regularly rounded; posterior side produced, with a narrow dorsal area limited by an ill-defined um-

Digitized by Google

bonal ridge extending to the somewhat pointed post-ventral extremity; post-dorsal margin gently sloping for half its length, thence more abruptly descending to form an acute angle with the moderately convex ventral margin.

The right valve has the anterior lateral tooth thick and short, the posterior longer and less stout; the doubling of these laterals is but faintly exhibited; the cardinal tooth is small. In the left valve there are no traces of the superior and supplementary laterals.

Pallial line with a broad, very shallow, posterior emargination

Dimensions.—Antero-posterior diameter, 12·5; umbo-ventral. diameter, 9·5; sectional diameter, 6 millimetres.

Locality.—Living in great abundance on the sandy bottom of Lake MacDonnell, Great Australian Bight. Lake MacDonnell is now entirely cut off from the ocean by lofty sanddunes; Zosteræ and other plants, as also several species of mollusca, still inhabit it.

The nearest ally of this pretty species is *M. cuneata*, Chem. It also bears some general resemblance to *Spisula fluviatilis*, Angas, but is more oblique and gibbous, not sharply angulated at the post-umbonal slope, and the dentition is very different.

Psammobia Brazieri, *spec. nov.* Plate v., fig. 1.

Shell elongate, somewhat donaciform, thin, shining, pellucid, slightly gaping at both ends, depressed; umbos small, acute, directed posteriorly, and situated far back.

The front dorsal margin is almost three times as long as the posterior, nearly horizontal and straight; the post-dorsal slope is very oblique and straightish. The ventral outline is but slightly curved, forming an obtuse rounded extremity anteriorly, and a blunt angle with the obliquely truncated posterior extremity. The posterior area is bounded by an acute umbonal carina, a little anterior to which on the interior is a thick ridge descending from the umbo and appearing on the exterior as an opaque white line.

Colour whitish, with a pink flame enclosed between the carina and the internal umbonal ridge. The sculpture consists of fine concentric lines of growth, becoming coarser on the posterior slope.

Dimensions.—Antero-posterior diameter, 12; length of posterior side, 3·5; umbonal ventral diameter, 6·5; sectional diameter of united valves, 2·25 millimetres.

Locality.—Aldinga Bay.

Tellina subdiluta, *spec. nov.* Plate iv., fig. 9.

Shell small, thin, semipellucid, white or pale yellow, shining; ornamented with close, regular, flat concentric ridges and linear interspaces; the ridges are slightly elevated, lamellar, fewer

Digitized by Google

and more distant on the posterior side. Elongate-oval, very inequilateral, a little convex; posteriorly narrow, rounded; anteriorly produced, acuminately rounded; post-dorsal slope very oblique, slightly concave behind the small acute umbo, thence a little ecurved to the rounded posterior margin; the antero-dorsal slope is very much longer, nearly straight. Right valve with two cardinal teeth, the posterior larger, triangular, and bifid; laterals well developed. Left valve with one bifid cardinal tooth only(?).

Dimensions. — Antero-posterior diameter, 9; umbo-ventral diameter, 5·5 millimetres.

Locality.—Dead shells from 22 fathoms in Encounter Bay.

This neat little species bears considerable resemblance to *T. diluta*, Smith, in Voy. Challenger, but is much shorter posteriorly, and otherwise a little different in outline, as also in sculpture.

Tellina Aldingensis, *spec. nov.* **Plate v., fig. 2.**

Right valve transversely elongate, subdepressed, much inequilateral; the anterior side larger than the posterior, rounded at the extremity and scarcely narrowed; posterior considerably attenuated, and narrowly truncated and inconspicuously biangulate at the extremity. The carination of the posterior slope is broadly and flatly convex, in front of which the shell is slightly depressed, but corresponding therewith on the interior there is a conspicuous, white, narrow ridge. Colour yellowish-white. The sculpture consists of linear striæ of growth, which are developed into slightly-raised laminæ on the posterior slope.

The siphonal inflection is very deep, reaching near to the anterior scar, narrowly rounded at the end, and confounded with the pallial line.

This species comes near to *T. imbellis*, Hanley.

Dimensions.—Antero-posterior diameter, 31; umbo-ventral diameter, 18; sectional diameter of right valve, 3; length of posterior side, 11·5 millimetres.

Locality.—Aldinga Bay.

Venerupis crebrelamellata, *spec. nov.* **Plate iv., figs. 14*a*—*b*.**

Shell oblong, somewhat elliptical, tumid about the umbones which are incurved, approximate, and anterior; anterior side attenuated; roundly truncated behind; concentrically closely exfoliated.

The anterior side is short, its dorsal margin straight, and very sloping, and forming with the abruptly ascending slope of the ventral margin a blunt angle; the post-dorsal side is slightly arched, descending to the narrow somewhat obliquely truncated posterior margin; the posterior part of the ventral

Digitized by Google

margin is nearly horizontal, thence rapidly ascending to the somewhat apiculate front extremity.

Sculpture.—On the umbonal region it consists of concentric ridges and raised radial lines; the interspaces between the ridges are concentrically striated and decussated by the radial lines. Proceeding outwards the ridges are gradually developed into thin, erect, crowded, crenately-wrinkled laminæ, which towards the posterior margin are broader and frilled; the radial lines of the umbonal area are continued as opaque pinkish-white thickenings in the crenatures on the dorsal face of the otherwise pellucid lamellæ.

Colour greyish, with a purplish or flesh-coloured stain about the umbones and posterior area.

The pallial line which is stained brown is near the margin; the sinus is narrow rather short and acute at the apex; the post adductor scar is purplish-brown and the anterior one pale-horn.

Dimensions.—Antero-posterior diameter, 24; umbo-ventral diameter, 14; sectional diameter, 13 millimetres.

Locality.—Burrowing in stiff clay on the north side of the mouth of the River Patawalonga, Holdfast Bay.

This species differs from all known species having lamellose ornament by its attenuated front and crowded lamellæ.

Corbicula desolata, *spec. nov.* Plate iv., figs, 11*a*—*b*.

Shell subtrigonally ovate, subequilateral, very convex with very prominent umbones; anterior side shorter, rounded at the margin, posterior margin more sharply curved.

Epidermis glossy, straw-coloured in young examples, brown in the adult. The ornament consists of distant, regular, acute, concentric ridges, passing into crowded raised lines on the posterior side where the epidermis is dull, darker in colour, and is crossed by fine oblique filaments.

Ligament short, brown. Interior of the valves bluish-white towards the margins, opaque-white towards the umbones. Hinge with three cardinal teeth in the right valve; the anterior one is small, the other two are grooved on their summits; the sockets for the lateral teeth are transversely striated. The left valve has two cardinal teeth, and the lateral teeth are transversely striated on both faces.

Dimensions.—Antero-posterior diameter, 17; umbo-ventral diameter, 15; sectional diameter, 11 millimetres.

Locality.—Cooper's Creek at Innamincka, Central Australia (*Mr. James McLeod!*).

C. desolata is related to *C. Angasi*, but differs by its more equilateral outline and great convexity,

Lucina crassilirata, *spec. nov.* Plate iv., fig. 2.

Shell orbicular, subglobose, very thick, regularly convex except in the post-dorsal area which is abruptly compressed. Surface

Digitized by Google

ornamented with thick concentric ridges, broader than the intervening concave sulci, and rather distant thickish threads which somewhat crenulate the margins of the liræ, but do not pass over them; inner margin of the valves strongly crenulated on the ventral region, minutely so on the front dorsal and posterior edges. Lunule small, shallow.

Dimensions.—Antero-posterior diameter, 8·5; umbo-ventral diameter, 8·25; sectional diameter, 7 millimetres.

Locality.—Shell sand, Streaky Bay.

This little species has a general resemblance to *L. columbella*, Lamarck, but has its closest ally in *L. nuciformis*, Tate, a fossil of the Older Tertiary beds of Aldinga Bay, from which it differs by being less gibbous, less angulated behind, and by its thicker liræ.

Lepton ovatum, *spec. nov.* Plate v., fig. 11.

Shell oval, thin, semitransparent, moderately convex, subinequilateral; umbos, blunt, approximate, projecting beyond the dorsal margin, slightly inclined to the front, situated a little behind the centre. Margins rounded on sides, except dorsally.

The sculpture consists of slight concentric striæ and microscopic granules. Owing to the transparency of the shell, the exterior exhibits the muscular scars and pallial line of the interior.

The right valve has one cardinal tooth, and the left valve two cardinal teeth, each with a lateral on each side, those of the right valve more remote.

Dimensions.—Antero-posterior diameter, 2; umbo-ventral diameter, 1·5; sectional diameter of closed valves, 1 millimetres.

Locality.—Shell sand, Holdfast Bay.

Kellia Angasiana, *spec. nov.* Plate v., fig. 7.

Triangularly oval, inequilateral, rather convex, extremely thin, dull, semitransparent. Dorsal margins sloping from the beaks towards each end, somewhat roundly truncate on the anterior side, roundly produced posteriorly, and the ventral margin moderately curved; umbo small, prominent, situated considerably in front of the centre.

The sculpture consists of numerous unequal elevated concentric threads.

Dimensions.—Antero-posterior diameter, 2·5; umbo-ventral diameter, 2; sectional diameter of both valves, 2 millimetres.

Locality.—Shell sand, Holdfast Bay.

Montacuta meridionalis, *spec. nov.* Plate v., fig. 4.

Ovately orbicular, sub-equilateral, somewhat gibbous, extremely thin, glossy, transparent, margins rounded; umbo

Digitized by Google

small, acute, hardly projecting beyond the dorsal margin, situated a little in front of the centre; posterior side the larger. The sculpture consists of fine concentric striæ.

Left valve with two diverging teeth, between which is the cartilage pit.

Dimensions.—Antero-posterior diameter, 10; umbo-ventral diameter, 8; sectional diameter of both valves, 4 millimetres.

Localities.—Shell sand, Aldinga Bay and Port Lincoln.

Scintilla (?) lunata, *spec. nov.* Plate iv., fig. 8.

Shell minute, approximately semicircular in outline, subequilateral, compressed, yellowish-white, dull, translucent; umbones small, though prominent, median, smooth. Surface of the valves concentrically faintly striated, and towards the margin minutely papillose, with a few larger papillæ grouped somewhat radially.

Dorsal line straight, the rest of the periphery almost uniformly arched, the posterior side being a little more attenuated than the anterior. Ventral gape wide, lanceolate. Ligament internal, bounded on each side in each valve by an obtuse tooth with a bifid crown and a long lateral. Margin of valves plain; interior nacreous, with the growth lines well shown.

Dimensions.—Greatest length of dorsal line, 7·25; greatest width, 3·5 millimetres.

Locality.—Creeping on rocks at extreme low tide at Edithburg, St. Vincent Gulf *(McDougall!)*

Cardita rosulenta, *spec. nov.* Plate v., fig. 3.

Shell trapezoidally ovate, transverse, moderately convex, inequilateral; umbones oblique incurved; anterior side short, obliquely and roundly truncated and flattened posteriorly; post-dorsal margin straight, slightly sloping; front-dorsal margin abruptly sloping and somewhat concave in front of the umbo. Lunule inconspicuous, broadly cordate, smooth. Surface ornamented with 22 very narrow subacute ribs, the anterior ones furnished with thickish annular scales, the middle and posterior ones with erect, arched, or subspinose scales; interspaces between the ribs concave, two or three times wider, concentrically, distantly, and irregularly striated.

Epidermis very thin, golden-yellow, minutely ciliate-fringed. Colour of shell whitish, the ribs pink and spotted with red; interior white, flesh-coloured from the umbo to the post-adductor scar.

Dimensions.—Antero-posterior diameter, 21; umbo-ventral diameter, 17; sectional diameter, 13 millimetres. Proportion 100:81:63.

Localities.—Small dead shells dredged in 22 fathoms, Encounter Bay, and in 32 fathoms, Backstairs Passage, and cast

Digitized by Google

up in Streaky and Fowler's Bays. Large living examples cast up at Rosetta Head, Encounter Bay (*R. H. Pulleine!*).

This new species has much the shape of *C. Preissii*, Menke, as figured by Reeve, from which it differs by being wider behind, with a well-defined posterior slope, and more convex; whilst the ribs are narrow, elevated, and more numerous. The proportion of the measurements of *C. Preissii* corresponding with those given above for *C. rosulenta* is 100 : 75 : 50. *C. rosulenta* makes a near approach to *C. scabrosa*, mihi, of the Old Tertiary of South Australia and Victoria, but has fewer ribs, and has not the arched dorsal line of that species.

Cardita obliquissima, *spec. nov.* **Plate v., fig. 9.**

Shell minute, very oblique and inequilateral, thick, white or pale rose colour. Anterior side much larger than the posterior, produced in front, pyriform; posterior side very narrow, abruptly sloping from an angulation extending from the umbo to the post-ventral margin; the whole surface is sculptured with distant, regular, somewhat wavy concentric grooves, and the posterior slope is ornamented with four or five radial riblets.

The hinge consists of a single thick, broad, triangular tooth in the right valve, which fits in between two more slender divergent teeth in the left.

Margins coarsely crenulated.

Dimensions.—Antero-posterior diameter, 3·75; umbo-ventral diameter, 3·25; sectional diameter through both valves, 2 millimetres.

Locality.—In shell sand at a depth of 22 fathoms, Encounter Bay.

Carditella subtrigona, *spec. nov.* **Plate iv., fig. 10.**

Shell triangularly ovate, somewhat solid, inequilateral, rather compressed, thick; umbones prominent, inclined forward, and considerably in advance of the centre. Surface ornamented with fourteen radiating costæ, which are covered with closely arranged, thick, compressed nodules; the interspaces are deep, a little narrower than the ribs, and are concentrically lirate.

The front dorsal margin is slightly concave in front of the umbo, thence rapidly sloping to the rounded anterior margin; the post-dorsal margin is ecurved, not so sloping, and longer than the front dorsal margin. The posterior margin is roundly truncated, and the ventral one regularly arched.

The inner margin of the valves is strongly and squarely dentate.

The left valve has two divergent cardinal teeth, the posterior one of which is considerably longer than the other; the right valve has a strong broadly triangular central tooth. There is

Digitized by Google

a lateral tooth on each side in both valves; the anterior one in the left and the posterior one in the right valve is submarginal.

Dimensions.—Antero-posterior, 5; umbo-ventral, 4·25; and sectional diameters, 2·75 millimetres.

Locality.—Dead shells cast up in Streaky Bay, Great Australian Bight.

This species is like *C. pallida*, Smith, the type of the genus, with which it agrees by the number of nodular ribs, but it differs as from all known species by its inequilateral triangularly ovate outline.

The genus Carditella was established by Mr. E. A. Smith in 1881 (Proc. Zool. Soc., p. 42) for Cardita-like shells with well developed lateral teeth on each side. It now comprises nine species—three on the west coast of South America, four Australian, one Cape of Good Hope, and one off Tristan da Cunha.

Limopsis rubricata, *spec. nov.* Plate v., fig. 6.

Obliquely oval, inequilateral, inflated; umbo very prominent, antemedian. Hinge line straight, the anterior margin obliquely descending.

Colour whitish, with four radial flames of chestnut beneath a thin light horn-coloured epidermis. The sculpture consists of regular concentric striæ, and towards the front margin of inconspicuous radial threads.

Margin of the valves coarsely crenulated all round. Hinge line with prominent teeth—three in front and five behind.

Probably a young shell, but not referrable to any known species.

Dimensions.—Antero-posterior diameter, 2·75; umbo-ventral diameter, 3; sectional diameter of united valves, 1·75 millimetres.

Locality.—Dredged in life from 32 fathoms in Backstairs Passage.

Pinna inermis, *spec. nov.* Plate iv., fig. 5.

Young shells up to 100 millimetres long, triangular-elongate, thin, semitransparent, slightly convex, ornamented with distant depressed longitudinal ribs and imbricating lamellæ of growth.

Colour light-horn, with a yellowish-brown band along the dorsal margin posterior to the ligament, and longitudinal streaks of the same colour on the rest of the surface.

The dorsal margin is straight, apical angle about 35°; the ventral margin slightly concave about the byssal orifice, thence slightly ecurved, the posterior end is truncated, the post-dorsal angle being 90° or less, joining the ventral margin with a rapidly ascending curve.

Digitized by Google

Adult shell cuneiform, somewhat elliptical, elongate, rather thick, semitranslucent, of a dark-brown colour, greyish towards the posterior margins where the lamellæ are densely imbricating and exfoliating.

In the anterior-third the valves are rather acutely convex, becoming increasingly depressed posteriorly; the axis of elevation is nearer the dorsal margin, and consequently the dorsal slope is steeper and shorter than that on the ventral side, which is undulatory ridged for about one-half or one-third of the whole length from the apex; posterior to the byssal orifice the ridges are marginal.

The dorsal margin nearly straight, varying from slightly convex to slightly concave; the ventral margin usually concave about the byssal orifice, thence convex to about two-thirds its length, where it commences to curve downwards to join the posterior margin. The posterior margin arched, somewhat produced, corresponding with the axis of elevation of the valve.

Surface ornamented with imbricating adpressed lamellæ and slight growth folds, especially on the anterior-ventral and-dorsal slopes; some individuals exhibit faint longitudinal ribs on the dorsal slope. Interior bluish-brown.

Dimensions of a large specimen.—Greatest length from the apex, 280 millimetres (14¼ inches); dorso-ventral diameter at right angles to the axis at two-thirds the whole length from the apex, 153 millimetres (six inches); greatest sectional diameter of both valves at about half the axial length, 51 millimetres (two inches).

Localities.—Vertically imbedded by their apices in the soft bottom of sheltered bays, just below low-tide mark; general from Eucla to the South-East.

This common so-called "razor-fish" has hitherto been known as *P. Zeylanica*, which name was applied to it by Angas in 1865, on the supposition that it is identical with the N.Z. shell. This identification is obviously erroneous, and is altogether inexplicable, as the two species are so widely different. The true *P. Zeylanica* has longitudinal ribs armed with close short semicylindrical hollow spines, and has a truncated posterior margin.

T. Woods (Proc. Tas. for 1875, p. 161) has evidently been misled, for in his description of *P. Tasmanica* he says, that in the few irregularly much-raised tubular scales it is quite distinct from *P. Zeylanica*, which is not uncommon in Australia. This author would seem to have been unacquainted with that species inasmuch as the characters he relies on by which to separate it from the species herein named, *P. inermis*, are such as ally it to *P. Zeylanica*, and raises a doubt if it be distinct from it.

Digitized by Google

Pecten Bednalli, *spec. nov.* Plate iv., figs. 3*a*—3*b*.

Shell somewhat triangularly orbicular, slightly convex, rather thin, scarcely equilateral, equivalve; ornamented with about 24 bundles of two or three subequal ribs, and shagreen sculpture in the interspaces. Ears very unequal, radially ribbed Colour of left valve purplish, with dashes or blotches of white. Right valve white, varied with pale flesh colour.

Dimensions.—Antero-posterior diameter, 28; umbo-ventral diameter, 25; sectional diameter, 8 millimetres.

This species is like *P. asperrimus* in shape and auricles, though it is a little more attenuated dorsally, but differs in the arrangement of the ribs and in the shagreened surface, by which latter character it resembles *P. bifrons*. The ribs increase in number from the umbonal region to the front by repeated bi- and tri-furcations, and are at first very little raised and plain; but towards the margin are subangular, and crowned with small prickly serratures (not scales, as in *P. asperrimus*). The ribs of each group of two are usually equal in size, but when three are together the middle one is usually stouter. Occasionally a single slender rib is interposed towards the front between the bundles.

Locality.—Aldinga Bay (*Mr. W. T. Bednall!*)

Pecten Pulleineanus, *spec. nov.* Plate iv., figs. 1*a*—1*b*.

This species is allied to *P. asperrimus*, but less orbicular and flatter. The ribs are 33 in number, simple, subacute, crossed by close-set continuous lamellæ—not interrupted on the flanks and in the sulci as in *P. asperrimus*. Anterior ear of right valve very narrow, elongate, radially ribbed; posterior ear, as in *P. asperrimus*, six-rayed raised into lamellose scales.

Dimensions.—Antero-posterior diameter, 23; umbo-ventral diameter, 19·5 millimetres.

Locality.—South-East coast (*Mr. R. H. Pulleine*!)

Among other Australian species it makes some approach to *P. cruentatus* and *P. blandus*, Reeve, but is not likely to be confounded with them.

Limea austrina, *spec. nov.* Plate iv., fig. 7.

Shell subovate, almost equilateral, very convex, solid, ornamented, with about twenty radiating nodulose ribs; the intervening sulci are somewhat narrower than the ribs, and are crossed by distant thickish liræ; umbones prominent, incurved; the hinge margin, on each side of the sunken broadly triangular ligament pit, is transversely minutely denticulated.

The outer margin of the valves is bluntly dentate, and the interior is regularly grooved, the furrows corresponding with the external costæ.

Digitized by Google

Dimensions.—Antero-posterior, 6; umbo-ventral, 7; and sectional diameters, 4·5 millimetres.

Localities.—Dead shells dredged from 33 fms, Backstairs Passage, and from 22 fms, Encounter Bay (*Pulleine*!). Also in Pliocene beds, Limestone creek, W. Victoria (*J. Dennant*!).

This pretty species has the form and sculpture of *Limatula Torresiana* (E. A. Smith,), but has fewer ribs and coarser concentric ornament, and by the presence of teeth on the hinge is removed generically from it.

EXPLANATION OF PLATES.

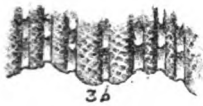
Plate IV.

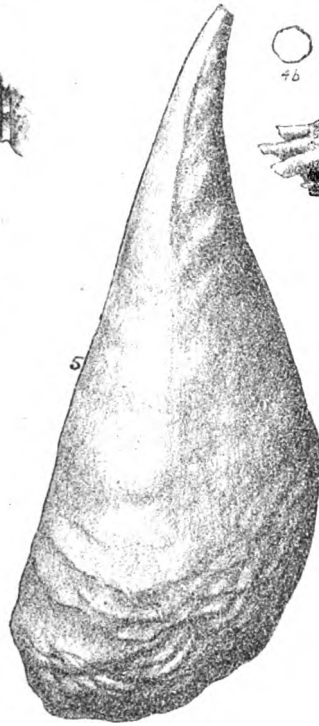
1. Pecten Pulleineanus, *Tate.* *a*, Right valve, nat. size; *b*, magnified view of portion of surface near the front.
2. Lucina crassilirata, *Tate.* Right valve enlarged.
3. Pecten Bednalli, *Tate.* *a*, Right valve and apical part of left valve, nat. size; *b*, magnified view of portion of surface at the front.
4. Aspergillum multangulare, *Tate.* *a*, Front view of the whole shell; and *b*, section of tube at the end; both enlarged.
5. Pinna inermis, *Tate.* Reduced from an example 18 inches long.
6. Paludina lirata, *Tate.* *a*, Back; and *b*, front views; nat. size.
7. Limea austrina, *Tate.* Much enlarged.
8. Scintilla lunata, *Tate.* Left valve, much enlarged.
9. Tellina subdiluta, *Tate.* Left valve, much enlarged.
10. Carditella subtrigona, *Tate.* Left valve, enlarged.
11. Corbicula desolata, *Tate.* *a*, Dorsal aspect; and *b*, right valve; nat. size.
12. Mactra versicolor, *Tate.* *a*, Dorsal aspect; and *b*, left valve; nat. size.
13. Mitra pellucida, *Tate.* Much enlarged.
14. Venerupis crebrelamellata, *Tate.* *a*, Left valve; and *b*, dorsal aspect; nat. size.

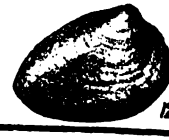
Plate V.

1. Psammobia Brazieri, *Tate.* Left valve, enlarged.
2. Tellina Aldingensis, *Tate.* Right valve, nat. size.
3. Cardita rosulenta, *Tate.* Right valve, nat. size.
4. Montacuta meridionalis, *Tate.* Left valve, much enlarged.
5. Semele exigua, *H. Adams.* Right valve, enlarged.
6. Limopsis rubricata, *Tate.* Right valve, much enlarged.
7. Kellia Angasiana, *Tate.* Left valve, much enlarged.
8. Semele Ada, *Adams & Angas.* Right valve, enlarged.
9. Cardita obliquissima, *Tate.* Left valve, much enlarged.

Digitized by Google



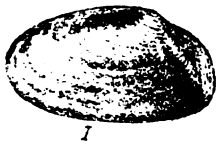


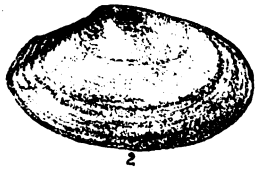


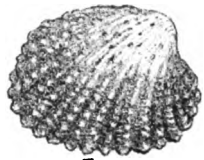
W.J.CHIDLEY DEL

Digitized by Google

Digitized by Google


1


2


3

4

5

6

7

8

9

10a

10b

11

12

13c

13b

13a

14c

14b

14a

15

16a

16b

WJ CHIDLEY DEL

Digitized by Google

Digitized by Google

10. Gastrochæna Tasmanica, *T. Woods.* *a*, Right valve; and *b*, dorsal aspect of united valves; enlarged.
11. Lepton ovatum, *Tate.* Left valve, much enlarged.
12. Pythina Tasmanica, *Tenison Woods.* Left valve, enlarged.
13. Helix Tomsetti, *Tate.* *a*, Front view; *b*, basal aspect; and *c*, view from above; nat. size.
14. Helix reteporoides, *Tate.* *a*, Front view; *b*, basal aspect; and *c*, view from above; enlarged.
15. Dosinia grata, *Deshayes.* Right valve, nat. size.
16. Modiola semivestita, *Dunker.* *a*, Left valve, and *b*, dorsal aspect of united valves; nat. size.

Digitized by Google

A Revision of the Recent Lamellibranch and Palliobranch Mollusca of South Australia.

By Professor Ralph Tate, F.G.S., F.L.S., &c.

[Read October 5, 1886.]

Peron, the naturalist to Baudin's Expedition (1802-3), carried the first conchological collection from South Australian waters to Europe. From the narrative of the Expedition written by Peron we learn that gatherings were made at the archipelago of the St. Francis Isles and at Nepean Bay, Kangaroo Island. The collection as a whole remains unpublished up to the present day; but Lamarck made some selections from it, which were described in his "Animaux sans Vertebres," vols. 5 to 7, 1818-1822; they consist of eighteen species of lamellibranchs and two of gastropods, a list of which here follows:—

1. Crassatella sulcata. Kangaroo Island and Shark Bay, W.A.
2. Crassatella cuneata. Kangaroo Island.
   [= Mesodesma (Anapa) cuneata.]
3. Amphidesma glabrella. Kangaroo Island.
4. Saxicava australis. Kangaroo Island.
   [= S. arctica, *Lin.*]
5. Venerupis distans. St. Peter and St. Francis Isles.
   [= V. exotica.]
6. Psammotea candida. Kangaroo Island.
   [= Macoma candida.]
7. Tellina albinella. St. Peter and St. Francis Isles.
8. Tellina capsoides. St. Peter and St. Francis Isles.
9. Tellina deltoidalis. St. Peter and St. Francis Isles.
10. Donax epidermia. Kangaroo Island.
    [= D. deltoides.]
11. Donax deltoides. Kangaroo Island.
12. Donax cardioides. St. Peter and St. Francis Isles.
13. Venus conularis. St. Peter and St. Francis Isles.
    [= Chione aphrodina.]
14. Venus aphrodina. Kangaroo Island.
    [= Chione aphrodina.]
15. Cypricardia rostrata. Kangaroo Island.
16. Isocardia semisulcata. St. Peter and St. Francis Isles.

Digitized by Google

17. Arca avellana. St. Peter and St. Francis Isles.
18. Perna nucleus. St. Peter and St. Francis Isles.
19. Fasciolaria coronata. Kangaroo Island.
20. Buccinum fasciatum. St. Peter and St. Francis Isles.
[= Nassa fasciata.]

The number of the bivalves is reduced to sixteen by exclusion of names considered synonymic; the following are recognised as inhabiting our waters:—*Crassatella cuneata*, *Saxicava australis*, *Venerupis distans*, *Tellina albinella*, *T. capsoides*, *T. deltoidalis*, *Donax deltoides*, *D. cardioides*, *Venus aphrodina*; the remaining seven are either indeterminate species, or if defined species then not certainly known to occur in South Australia. That the names of localities have in some instances been misquoted is very certain. Of the six Lamarckian types of *Psammotea candida* in the Paris Museum, Von Bertin says that one is labelled from Timor, one from China, and four are without localities. Nevertheless, though we may cast a doubt as to the accuracy of the record of observation, yet we should hesitate to reject *in toto*; for eighty years *Donax cardioides* had remained unobserved in the region whence it was first obtained.

The late Mr. Cuming extended his collecting tour to our waters, and many new species then obtained by him have been described by Reeve, Sowerby, Adams, and other monographers. The Cumingian collection, on the death of its founder, was acquired by the British Museum.

As a result of several years' personal collecting in this province, Mr. G. F. Angas published in the Proceedings of the Zoological Society for 1865 a list of all the known species of marine mollusca known to inhabit South Australian waters; previously to the publication of which many new species were scientifically diagnosed by MM. Crosse and Fisher, himself, and others. This list contains the names of ninety-six species of Lamellibranchs and one Palliobranch.

Mr. W. T. Bednall, in a List of Species of our Marine Mollusca privately printed, added a few bivalves not previously recorded.

Through material communicated by me, Mr. G. F. Angas published in 1878 a first Supplement, and in the following year a second Supplement to the List of our Marine Mollusca. From these sources the total number of Lamellibranchs was brought up to 116, and the Palliobranchs to 2. Of the 116 names of bivalves 13 are considered synonymic, thereby reducing the number of species to 103; by recent accessions chiefly and by the recognition of a few Lamarckian species as endemic in the province, the total number of known species of Lamellibranchiata is 166, including 9 freshwater species, and of

Digitized by Google

Palliobranchiata, 5. The publication of a revised list of our bivalves has further been rendered desirable by reason of considerable changes in the nomenclature. Some of the alterations consist in the substitution of prior names, and a few of them are a consequence of more correct identification.

To render this list a partial aid to the determination of the species, I have added brief characters to each when considered necessary.

I have thought it superfluous to furnish all localities at which a common species occurs, and only in the case of rare species have localities and the collectors' names been given. The sign (!) following the collector's name indicates that I have examined specimens from the reported locality. In every instance I have exercised the utmost care in investigating the circumstances under which the species were obtained to the exclusion of all possible scources of accidental introduction.

The chief collections which I have had under examination are those of Mr. W. T. Bednall, embracing the coast-line from Port Lincoln to the South-east; Mr. Forwood, Holdfast Bay; Mr. Tepper, Ardrossan; Dr. Gosse, Wallaroo Bay; Mr. McDougall, Southern Yorke's Peninsula; Mr. Pulleine, St. Vincent Gulf and South-east coast; the South Australian Museum, St. Vincent Gulf. I have to acknowledge also my obligations to Mr. Brazier, of Sydney, for his assistance in the determinations of some critical species; by reason of his extensive conchological library and accurate knowledge of Australian species, a value is attached to his identifications, which few authors can attain to. Personal explorations during the past eleven years have embraced all the more important collecting stations from the mouth of the river Glenelg to Eucla.

Dredging operations have been undertaken only to a limited extent, being chiefly restricted to the shallow waters of the Port Adelaide creek and St. Vincent Gulf. A haul from 32 fathoms in Backstairs Passage brought to light a few species hitherto unknown to occur with us. Mr. Pulleine's dredgings in deep water off Encounter Bay, carried on during the early months of this year, have been more fruitful of results, and the oyster dredgings in the Port Lincoln District have furnished some little information. And though we may congratulate ourselves with an extensive acquaintance with the Molluscan life of the littoral and shallow water regions, yet we do anticipate a new revelation when the deeper parts of our oceanic waters shall have been explored.

The following list embraces all the species previously recorded under specific names different from those employed in the present work and such as are excluded or unrecognisable. In the first column are given the names hitherto used; in the

Digitized by Google

second the author of the record, and in the third the specific names herein adopted, or the reason for the exclusion of the species :—

Corbula nasuta [Sow.], *Angas*.	C. scaphoides, *Hinds*.
Saxicava australis, *Lamarck*. Saxicava Angasi, *Adams*.	S. arctica, *Linn*.
Lutraria Philippinarum [Desh.], *Angas*.	L. dissimilis, *Desh*.
Spisula Adelaidæ, *Angas*.	Mactra ovalina, *Lk*.
Amphidesma glabrella, *Lamarck*.	Not recognised.
Mesodesma obtusa, *Crosse* and *Fischer*.	M. præcisa, *Desh*.
Donax deltoides, *Lamarck*.	D. epidermia, *Lk*.
Soletellina epidermia, *Reeve*. Soletellina nymphalis, *Reeve*.	S. biradiata, *Wood*.
Psammotea candida, *Lamarck*.	Locality erroneous.
Venerupis distans, *Lamarck*.	V. exotica, *Lk*.
Chione alta [Sow.], *Angas*.	C. tiara, *Dillwyn*.
Chione australis [Sow.], *Angas*.	C. gallinula, *Lamk*.
Chione conularis, *Lamarck*. Chione Peroni, [Lamarck], *Angas*.	C. aphrodina, *Lk*.
Circe rivularis [Menke], *Angas*.	C. corrugata, *Chemnitz*, var. crocea, *Gray*.
Marcia faba [Reeve], *Angas*.	Chione lævigata, *Sow*.
Callista Victoriæ, *T. Woods* and *Angas*.	Cytherea rutila, *Sow*.
Chama fragum [Reeve], *Angas*.	C. spinosa, *Broderip*.
Thecalia macrotheca, *Adams* and *Angas*.	Mytilicardia concamerata, *Chem*.
Lucina Cumingi, *Adams* and *Angas*.	L. quadrisulcata, *D'Orb*.
Loripes ovum [Reeve], *Angas*.	Cryptodon globosum, *Forsk*.
Crassatella sulcata, *Lamarck*.	Not known here.
Isocardia semisulcata, *Lamk*.	Not known.
Cypricardia rostrata, *Lamk*.	Locality erroneous.
Lassæa australis [Sow.], *Angas*.	Lassæa rubra, *Montagu*.
Mysella anomala, *Angas*, 1878 (non '77)	Kellia solida, *Angas*.
Perna flavida [Dunker sp.], *Angas*.	Modiola semivestita, *Dunker*.
Lanistina nana, *Dunker*. Crenella Adolphi, *Dunker*.	Modiolaria Cumingiana, *Rv*.
Malleus regulus [Forsk.], *Angas*.	M. vulsellatus, *Lamk*.
Pinna Zeylanica, *Angas* (non Gray).	P. inermis, *Tate*.
Vulsella limæformis, *Reeve*. Vulsella rudis, *Reeve*.	V. ovata, *Lamarck*.
Perna nucleus, *Lamarck*.	Not known.
Avicula scalpta, A. pulchella, A. rutila, and A. punctulata [all of Reeve], *Angas*.	A. Georgiana, *Quoy* and *Gaimard*.
Arca avellana, *Lamarck*.	Not recognised.

Digitized by Google

Pectunculus laticostatus, *Angas* (non Quoy and Gaimard).	P. flabellatus, *T. Woods*.
Limopsis Macgillivrayi [A. Adams], *Angas*.	L. Belcheri, *Ads.* and *Rv.*
Pecten australis [Sow.], *Angas*.	P. asperrimus, *Lamarck*.
Pecten laticostatus, *Angas* (non Gray).	P. fumatus, var. albus, *Tate*.
Lima squamosa, *Angas* (non Lamk.).	L. multicostata, *Sow.*
Ostrea cucullata [Born], *Angas*.	Not living here.
Ostrea edulis [Linn?], *Angas*.	O. Angasi, *Sow.*

A large majority of the molluscan inhabitants of our ocean waters are common to the province which embraces the coast-line of extratropical Australia; of the Lamellibranchiata, 130 species belong to it, of which 32 are unknown at present beyond the limits of this colony; 26 species are migrants from the Indo-Pacific Province which extends to North Australia, and reaches on the west coast to Shark Bay and on the east to Port Curtis or Wide Bay; two, if not three, are cosmopolitan.

Of the species of Palliobranchs, four are essentially Australian, whilst the fifth is common to South Australia and Chili.

The greatest community of species of bivalves is with Tasmania, 75 actually known; with New South Wales, 63; with south-western Australia, 31; with Victoria, 29; and with New Zealand, 15.

The following exotic species appear sporadically, as it were, in South Australia:—*Gastrochæna lamellosa*, *Tellina capsoides*, *Venerupis exotica*, *Donax cardioides*, *Lucina fabula*, *Carditella infans*, and *Barbatia lima*.

CLASS LAMELLIBRANCHIATA.

Family Teredinidæ.

1. Teredo sp.

Burrowing in submerged timber, Holdfast Bay and Port Adelaide.

Tube thin, slender, septated internally; valves like *T. norvegica*. Siphonal pallets unknown, therefore the exact systematic position indeterminable. Possibly it may be *Xylotrya antarctica*, Hutton, inhabiting New Zealand and Queensland.

Family Pholadidæ.

2. Barnea similis, Gray, in Dieffenbach's N. Zealand, vol. 2, p. 254; also Reeve's Mon. Pholas, f. 10.

Burrowing in clay at low-tide mark, Port Lincoln, St. Vincent Gulf, and South-East coast; also in Tasmania, New South Wales, and New Zealand.

A white delicate shell, acuminate anteriorly.

Digitized by Google

3. Barnea australasiæ, Sowerby, in Thesaurus Conchyliorum, t. 107, f. 73.

Burrowing in soft rock just below low-tide mark, from the Head of the Great Australian Bight to Gulfs Spencer and St. Vincent; also in Tasmania.

Similar to the last, but rounded anteriorly.

4. Jouannetia Cumingi, Sowerby.

MacDonnell Bay *(W. Tomsett!)*; also New South Wales *(J. Brazier)* and Port Darwin *(W. T. Bednall!)*

Anteriorly globose and covered by a callous plate, acuminate posteriorly.

Family Gastrochænidæ.

5. Aspergillum (Humphreyia) Strangei, A. Adams, in Proceedings Zoological Society, 1852, p. 91, t. 15, f. 15; Reeve, Mon., t. 2, f. 4.

Holdfast Bay *(W. T. Bednall!)*; also Tasmania and New South Wales.

Tube stout, squarely rounded, and obtusely keeled at the angles. Length, about two and a-half inches.

6. Aspergillum (Humphreyia) multangulare, Tate, *anteà*, p. 64, t. 4, f. 4.

Holdfast and Aldinga Bays in Gulf St. Vincent, and Wallaroo Bay in Gulf Spencer.

Tube slender, polygonally rounded, angles not keeled. Total length, about one inch.

7. Gastrochæna lamellosa, Deshayes, in Proc. Zool. Soc., 1854, p. 328; Smith, in Zoology of the Challenger, pt. 35, t. 8, f. 2, p. 28, 1885.

Burrowing in sponge, Backstairs Passage, in 32 fathoms; also Philippine Islands, Cape York (Challenger Exp.), and Port Darwin (*Bednall!*)

Dorsal margin sloping, widening posteriorly; surface of valves raised into close-set lamellæ. Length, about one and a-quarter inches.

8. Gastrochæna Tasmanica, Tenison Woods, in Proc. Roy. Soc. Tasmania for 1876, p. 159. Pl. v., figs. 10*a*—10*b*.

Burrowing in limestone, forming the bed of Port Adelaide Creek; in the test of Chamæ and encrusted growth on Pinnæ, Holdfast and Aldinga Bays; also Tasmania!

Dorsal margin nearly straight, ventral gape occupying whole length of margin; surface concentrically striated. Length, under half-inch.

Digitized by Google

FAMILY SOLENIDÆ.

9. SOLEN VAGINOIDES, Lamarck, in Animaux sans Vertebres, vol. v., p. 451, 1818.

Port Adelaide Creek; Nepean and Hog Bays, Kangaroo Island. The type specimens from Tasmania.

Shell nearly straight, about four times as long as wide, mottled with purple and flesh colour. Length, three and a-half inches.

FAMILY SAXICAVIDÆ.

10. SAXICAVA ARCTICA, Linnæus.

In the crevices of rocks; immersed in the bases of large Ascidians, upon oysters, &c., throughout South Australia.

This polymorphic species is world-wide in its distribution. Lamarck named specimens obtained at Kangaroo Island *S. australis;* and large individuals attaining to two and a-half inches long from our waters had been provisionally named *S. Angasi* by A. Adams. It is a member of the Eocene fauna of South Australia and of the New Zealand Pliocene.

FAMILY CORBULIDÆ.

11. CORBULA SCAPHOIDES, Hinds; Reeve, Mon., t. 3, f. 47.

Cast up at Fowler's Bay; Wallaroo Bay; Hog Bay, Kangaroo Island; and at several localities in St. Vincent Gulf. Dredged in life from eight to 22 fathoms in Encounter Bay (*Pulleine!*); also New South Wales, North Australia, and the East Indies.

Distinguished by being nearly equivalve, by its small umbones and radial sculpture; length five-eighths of an inch. Angas has catalogued it in Proc. Zool. Soc., p. 869, 1878, as *C. nasuta*.

12. CORBULA TUNICATA, Hinds; Reeve, Mon., t. i., f. 5.

Dredged in life from 22 fathoms, Encounter Bay (*Pulleine!*); Aldinga Bay; also New South Wales to North Australia and the Philippines.

Very inequivalve; the larger valve with tumid umbones; surface with thick concentric ribs; length, five-eighths of an inch.

FAMILY ANATINIDÆ.

13. ANATINA ANGASI, Crosse and Fischer (*Periploma*), in Jour. de Conch., 1864, p. 349; 1865, p. 427, t. 11, f. 1.

Hardwicke Bay, Spencer Gulf (*Angas*); Coffin Bay (*S. Aust. Mus.!*); Port Lincoln and Port Adelaide Creek (*R. T.*). Also Tasmania and New Zealand.

Distinguished by the inequality of its valves; attaining to a length of three inches by a breadth of one and three-quarters.

14. ANATINA CRECCINA, Reeve, Mon., t. 2, f. 12.

Hardwicke Bay (*Angas*), Wallaroo (*Gosse!*), in Spencer

Digitized by Google

Gulf; Coffin Bay (*S. Aust. Mus.!*); and off the mouth of the Patawalonga, Holdfast Bay (*Bednall!*). Common at Corio Bay, Port Phillip, thence extending to Queensland.

An oblong inequilateral shell, widely gaping and curved upwards posteriorly; length, two and a half inches.

15. ANATINA GRACILIS, Reeve, Mon., t. 2, f. 9.

Port Adelaide Creek, Holdfast Bay, and Wallaroo. Also Moreton Bay, Queensland.

A narrow oblong shell, almost equilateral, one and three-quarter inches long.

16. MYODORA BREVIS, Sowerby; Reeve, Mon., t. 1, f. 7.

Denial Bay, Great Australian Bight. Also Tasmania to Queensland and New Zealand.

Right valve with small much incurved beak, triangular, ornamented with flexuous ribs.

17. MYODORA OVATA, Reeve, Mon., t. 1, f. 4.

Port Adelaide Creek(!); Encounter Bay (*R. H. Pulleine!*). Also Tasmania and New South Wales; doubtfully Philippine Islands (*Reeve*).

Right valve ovate, somewhat triangular, with about 20 thick concentric ribs.

18. MYODORA ANGUSTATA, Angas (*Alicia*), in Proc. Zool. Soc., 1867, t. 44, f. 1, p. 908.

Dead shells dredged in 22 fathoms, Encounter Bay (*R. H. Pulleine!*). Also in New South Wales.

A narrowly oblong shell with the aspect of a *Thracia*, upon which Angas founded the genus of *Alicia*, but which E. A. Smith, in Voy. of Challenger, removed to *Myodora*; length, half an inch.

FAMILY MACTRIDÆ.

19. MACTRA RUFESCENS, Lamarck, An. s. Vert., v., p. 476.

Great Australian Bight; Encounter Bay and southward. Extends from Shark Bay (*Lamarck*) to Tasmania.

Broadly triangular, solid, pale-brown, somewhat pointed at the extremities, towards which the surface is flexuously wrinkled; length, two inches.

20. MACTRA PURA, Deshayes, in Proc. Zool. Soc., 1853, p. 15.

St. Vincent and Spencer Gulfs; Fowler Bay, Head of the Great Bight, and Eucla. Also King George Sound and Tasmania.

Solid, ivory-white beneath a light-brown silky epidermis; larger, more solid, and less equilateral than the last; length, one and three-quarter inches.

Digitized by Google

21. MACTRA POLITA, Chemnitz; *M. australis*, Lamarck, An. s. Vert., v., p. 475.

Common in sand at low water. St. Vincent and Spencer Gulfs; Fowler Bay and Head of Great Australian Bight. Also King George Sound (Lamarck's type).

Triangularly ovate, rounded anteriorly; banded with light-grey and violet beneath a pale-brown epidermis; length, one and a half inches.

22. MACTRA JACKSONIENSIS, E. A. Smith, Voy. Challenger, t. 5, fig. 9, p. 62, 1885.

Hog Bay, Kangaroo Island; Streaky Bay, Great Australian Bight. Also Port Jackson!

Triangularly elongate, equilateral, shining usually white rayed with brown; five-eighths of an inch long.

23. MACTRA AMYGDALA, Crosse & Fischer, in Journ. de Conch., 1865, p. 426, t. 11, f. 3.

Head of Spencer Gulf (*Angas*).

An oval white species, truncated posteriorly, about half an inch long.

24. MACTRA (HEMIMACTRA) VERSICOLOR, Tate, *anteà*, p. 64, t. 4, figs. 12*a*—12*b*.

Lake MacDonnell towards the Great Australian Bight.

Triangularly ovate, obliquely truncated behind, shining, white, yellow, brown, purplish or bluish-white, concentrically lirate; length, half an inch.

25. MACTRA (HEMIMACTRA) OVALINA, Lamarck in An. s. Vert., v., p. 477 (1818). *Spisula Adelaidæ*, Angas in Proc. Zool. Soc., 1865.

Holdfast, Aldinga, and Encounter Bays; Port Adelaide Creek (type of *S. Adelaidæ*). Also Victoria and New South Wales.

Ovate, white, rufous tinted about the umbos, posterior slope slightly keeled, rather gaping posteriorly; about one inch long by three-eighths high.

26. MACTRA (MULINIA) PINGUIS, Crosse & Fischer, Journ. de Conch., 1865, t. 11, f. 2, p. 427.

Port Lincoln (*Angas*).

Oval trigonal, much inflated and thick, fulvous, colour darker towards the extremities; length about one inch.

27. LUTRARIA RHYNCHÆNA, Reeve, Mon., t. 4, f. 16.

Dredged on oyster banks off Port Lincoln (*Angas*).

Obliquely arched, with the anterior side beaked.

Digitized by Google

28. LUTRARIA DISSIMILIS, Deshayes, in Proc. Zool. Soc., 1854, p. 72.

Surveyor's Point, Port Adelaide Creek, and Aldinga Bay, in St. Vincent Gulf; Port Lincoln, Fowler's Bay; also Tasmania and New South Wales.

A large thick species attaining to three and four inches long; ventral and dorsal margins nearly parallel, covered with a dirty brown epidermis.

FAMILY SCROBICULARIDÆ.

29. SEMELE ADA, Adams and Angas, in Proc. Zool. Soc., 1863, p. 426. Plate v., fig. 8.

Port Adelaide Creek (*Angas*), Holdfast Bay, Wallaroo Bay, and Fowler Bay.

Transversely-ovate, thin, white, compressed, concentrically rugose-plicate, excavated in front of the acute umbos; front side rounded, posterior side shorter, obtuse-angled; under half an inch long.

30. SEMELE EXIGUA, H. Adams, in Proc. Zool. Soc., 1861, p. 385. Plate v., fig. 5.

Holdfast Bay, Stansbury, and Streaky Bay. In sand near low tide mark, Spencer Gulf (*Angas*).

The type specimens are reported from Tasmania, but according to Tenison Woods the species is not known there.

A white oblong shell, finely concentrically striated, posterior side subangulated with a strong fold continued to the ventral margin; length, about five-eighths of an inch.

FAMILY PAPHIDÆ.

31. MESODESMA PRÆCISA, Deshayes, in P. Z. S., 1854; id. Reeve, Mon., t. 4, f. 31. *M. obtusa*, Crosse and Fisher, Journ. de Conch., 1865, t. 11, f. 4, p. 428.

In sand at low water, Holdfast Bay, and west shore of St. Vincent Gulf, Port Lincoln! (type locality of *M. obtusa*); Streaky and other bays in the Great Australian Bight; Spencer Gulf.

This species was founded on Tasmanian specimens; it also inhabits King George's Sound!

Ovate, waxy-white, roundly truncate behind; about one inch long.

32. MESODESMA ELONGATA, Deshayes, P. Z. S., 1854; id. Reeve, Mon., t. 1, f. 25.

On all sandy beaches, and occurs all round Australia.

Triangularly elongated, posterior side short and truncated, light-horn coloured; under one inch long.

Digitized by Google

33. ANAPA CUNEATA, Lamarck (*Crassatella*), An. s. Vert., v., p. 483. *Mesodesma cuneata*, Reeve, Mon., t. 2, f. 9.

Towards high-tide mark. Port Adelaide Creek and west shore of St. Vincent Gulf; Port Lincoln; Denial and Laura Bays; Kangaroo Island (Lamarck's types).

A thick triangular shell, produced posteriorly, whitish, concentrically striated; length, about one inch.

34. ANAPA TRIQUETRA, Hanley, Proc. Zool. Soc., 1843, p. 101; Reeve, Mon. of Mesodesma, t. 4, f. 28. *Anapa Smithii*, Gray; *Anapa Tasmanica*, Tenison-Woods.

Between tide marks, Port Adelaide Creek. Head of Spencer Gulf (*Angas*).

The type shell is from Tasmania.

Similar to the last, more tumid, less inequilateral, and somewhat truncated posteriorly.

FAMILY TELLINIDÆ.

35. DONAX EPIDERMIA, Lamarck, An. s. V., v., p. 548. *D. deltoides*, Lamarck, op. cit., p. 547.

Very abundant on the sandy shores extending southward from Encounter Bay. The Lamarckian types were collected by Peron at Kangaroo Island.

This species ranges from King George Sound to Queensland, though not recorded for Tasmania.

Cuneate, smooth except on the posterior area, which is radially striated; colour greenish, yellow, purplish; inner margin of valves smooth; length, about two inches by one and a quarter.

36. DONAX CARDIOIDES, Lamarck, An. s. V., v., p. 550; id. Quoy and Gaimard, Voy. Astrolabe, t. 81, f. 17-19, vol. 3, p. 495.

Dead shells dredged in 22 fathoms, Encounter Bay (*R. H. Pulleine!*); cast up southern Yorke Peninsula (*J. G. McDougall!*). St. Peter and St. Francis Isles (Lamarck's types). Also New Guinea, Tahiti, and New Ireland (*Quoy and Gaimard*). Aru Islands (coll., *W. T. Bednall!*).

Trigonal, medially inflated, radiately ridged, umbos prominent, spotted with reddish-brown; inner margin of valves denticulated; length, about three-quarters of an inch.

37. DONAX SORDIDA, Reeve, Mon., t. 4, f. 32.

Port Lincoln (*Angas*).

At low tide on the sandy beach at the Head of the Great Australian Bight; cast up, Hog Bay, Kangaroo Island. Locality of type unknown.

Cuneiform, flattened, umbos small, posterior side very short,

Digitized by Google

radiately striated; colour white, greenish, orange, purplish; inner margin of valves denticulated. Length, three quarters of an inch.

38. PSAMMOBIA ZONALIS, Lamarck (*Psammotea*), An. s. Vert. v., p. 517.

Hog Bay, Kangaroo Island (*R. T.*), Encounter and Guichen Bays (*R. H. Pulleine!*). Also Tasmania, N. S. Wales, Queensland, Philippine Islands, &c.

Ovately transverse, truncated posteriorly, compressed, concentrically finely striated, pale brown with white rays. Length, about one and a half inches.

39. PSAMMOBIA BRAZIERI, Tate, *anteà*, p. 65., t. v., f. 1.

Aldinga and Holdfast Bays.

40. SANGUINOLARIA VITREA, Deshayes in P. Z. S., 1854, p. 326; id. Reeve, Mon., t. 1, f. 1.

Port Lincoln and Spencer Gulf (*Angas*); Surveyor's Point and Holdfast Bay. Also Tasmania.

Shell thin, white, transparent, narrow-oblong; dorsal and ventral margins nearly parallel, marrower than young of *Soletellina biradiata*. Length, three quarters to one inch.

41. SOLETELLINA BIRADIATA, Wood (*Solen.*), in Gen. Conch., t. 33, f. 1; Reeve, Mon., t. 2, f. 7; *S. epidermia*, Reeve, Mon., t. 1, f. 3, and *S. nymphalis*, Reeve, Mon., t. 1, f. 2,

In sand below low tide mark, common in St. Vincent and Spencer Gulfs, Fowler's Bay, and Port Adelaide (types of *S. epidermia* and *S. biradiata*, Reeve). The species ranges from King George Sound to New South Wales.

S. epidermia and *S. nymphalis*, Reeve, are mere colour varieties of *S. biradiata*.

Shell roundly oblong, colour white, yellow to purple, with two white rays from the umbo to the post-ventral margin, which is rapidly ascending. Length, two and a quarter inches.

42. SOLETELLINA DONACIOIDES, Reeve, Mon., t. 3, f. 11, 1857.

Port Adelaide Creek (type in Cuming Coll.); St. Vincent Gulf (*W. T. Bednall!*).

Transversely-oblong, livid purple, with two faint posterior rays; posterior side more oblique than in the last species. Length, two and a quarter inches.

Perhaps conspecific with *Psammobia florida*, Gould, which name has priority, in which case the species inhabits also New South Wales.

43. TELLINA ALBINELLA, Lamarck, An. s. Vert., v., p. 524 (1818), id. Römer, Mon. Tellin, t. 27, f. 1—4 (1872).

Digitized by Google

Abundant on the sandy beach about the mouth of the River Murray; occasionally in Holdfast and Aldinga Bays; St. Peter and St. Francis Isles (Lamarckian types); Fowler's Bay. Extends to Tasmania and New South Wales.

About two inches long, oval, compressed, subangulated posteriorly; pink or orange, rarely white.

44. TELLINA DELTOIDALIS, Lamarck, op. cit., p. 532 (*exclus. var. b.*). *T. lactæa*, Quoy and Gaimard, Voy. Astrolabe, t. 81, f. 14—16.

Between tide marks in the estuary of the Port Adelaide Creek, the Patawalonga and Onkaparinga, St. Vincent's Gulf; Encounter Bay; also St. Francis Isles (Lamarckian types). It occurs in Victoria, Tasmania, and New South Wales; New Zealand, New Caledonia, Acapulco.

Shell roundly triangular, compressed, subrostrated, white. Length, about one inch.

45. TELLINA CAPSOIDES, Lamarck, An. s. V., v., p. 531; id. Römer, Mon. Tell., t. 14, f. 1—3.

St. Peter and St. Francis Isles; also at the Philippines (*Peron, Lamarck*).

Broadly trigonal, subequilateral, concentrically and radiately striated; anterior side bisulcated; white. Length, one and three-quarter inches (*Lamarck*).

46. TELLINA TENUILIRATA, Sowerby, in Reeve, Mon., t. 39, f. 219.

Hog Bay, Kangaroo Island; Streaky Bay; Port Adelaide Creek; also New South Wales, N. Australia, and Fiji.

Oblong, posterior side very short, cuneiform; post-ventral margin rapidly ascending; concentrically finely ridged. Length, three-eighths of an inch.

47. TELLINA SUBDILUTA, Tate, *anteà*, p. 65, t. 4, f. 9.

Encounter Bay, in 22 fathoms.

Ovately oblong, rounded on the very short posterior side, attenuated anteriorly; finely concentrically ridged. Length, three-eighths of an inch.

48. TELLINA ENSIFORMIS, Sowerby, in Reeve, Mon., t. 49, f. 289 (1868).

Aldinga Bay; Australia (*Sowerby*).

Left valve, broadly triangular-ovate subequilateral, much curved longitudinally, attenuated and subrostrated behind; transparent, white; length one inch, width a little more than half-inch.

49. TELLINA ALDINGENSIS, Tate, *anteà*, p. 66, t. 5, f. 2.

Aldinga Bay.

Digitized by Google

50. TELLINA DECUSSATA, Lamarck, An. s. Vert., v., p. 532; Römer, Mon. Tellina, t. 23, f. 1—3, 1873.

Occurs on the whole length of our coast. but is not a common shell. It ranges from King George Sound (*Lamarck*) to New South Wales.

Orbicular with decussate ornament, about two inches diameter.

51. MACOMA MARIÆ, T. Woods, in Proc. Roy. Soc. Tasmania for 1875, p. 162, as a Tellina; *Macoma rudis*, Bertin, Archives Mus. Hist. Nat., 1878, t. 9, f. 2, p. 335.

St Vincent Gulf, Fowler's Bay, Streaky Bay, Encounter Bay, Lacapede Bay; only at the last locality is it at all common.

Bertin's type is from Port Philip. I have collected the species at Corio Bay. Tasmanian examples of *M. Mariæ* perfectly agree with description and figures of *M. rudis*. Tenison Woods implies in his description of the species a reference to the genus Macoma, and the diagnosis is amply sufficient for identification.

Transversely elliptical, white, gaping, and roundly truncated posteriorly; length up to one and a quarter inches.

52. METIS UMBONELLA, Lamarck (*Tellina*); An. s. Vert., v., p. 532; id. Hanley Mon. Tellina, t. 56, f. 13; Reeve, Mon., t. 38, f. 214,

Port Lincoln (Cuming coll.); King Island (Lamarck).

The Australian localities have been usually considered to be erroneous. The species is not known here, and Tenison Woods does not mention it in his census of Tasmanian Marine Shells. Bertin says, however, it inhabits New Holland, and is represented in the Paris Museum by an original specimen from King Island (type of Lamarck). So far as known, it would appear to be peculiar to Southern Australia.

FAMILY PETRICOLIDÆ.

53. NARANIO DIVARICATA, Chemnitz, sp. *Petricola lucinalis*, Lamarck, loc. cit., p. 504.

Holdfast and Aldinga Bays, Port Lincoln. Also at King George Sound (*Lamarck*), Port Darwin !, and Indian Ocean.

Thin, ventricose, divaricately sculptured.

54. VENERUPIS EXOTICA, Lamarck, An. s. Vert., v., p. 507; Reeve, Mon., t. 2, f. 11; *V. distans*, Lamarck, op. cit., p. 507.

Streaky Bay (R. T.); Corney Point, Yorke Peninsula (*McDougal!*); St. Francis Isles (*Lamarck*).

V. distans was described from specimens collected by Peron at St. Peter and St. Francis Isles; the species has not been recognised, but from the diagnosis it should be absorbed in

Digitized by Google

V. exotica. The locality of the type of *V. exotica* is unknown, but the species occurs in North Australia.

Ovate rhomboidal, post-dorsal and ventral margins nearly parallel, radially costated, transverse lamellæ few and distant, white or yellowish, painted with red angular lines posteriorly.

55. VENERUPIS CARDITOIDES, Lamarck, loc. cit., p. 508; Reeve, Mon., t. 1, f. 5.

Hog Bay, Aldinga Bay, Port Adelaide Creek, Encounter Bay. Also West Australia and Tasmania, New Holland (*Lamarck*).

Very closely allied to the last, the dorsal margins more sloping, concentric lamellæ more numerous.

56. VENERUPIS CRENATA, Lamarck, loc. cit., p. 508; Reeve, Mon., t. 1, f. 3.

At the roots of mangrove trees, Port Adelaide Creek (*Angas*); Noarlunga, Encounter and Guichen Bays. Also Tasmania and New South Wales, New Holland (*Lamarck*).

This, the largest of our species, is oblong, rather inflated, concentrically exfoliated and irregularly frilled, decussated by radial costæ.

57. VENERUPIS CREBRELAMELLATA, Tate, *anteà*, p. 66, t. 4, figs. 14*a*—14*b*.

Burrowing in stiff clay at the mouth of the Patawalonga, Holdfast Bay.

Narrow oblong, attenuated in front, densely concentrically exfoliated frilled; nearly one inch long.

58. VENERUPIS MITIS, Deshayes, P. Z. S., 1853; Reeve's Mon., t. 4, f. 24.

Port Elliot. Also New South Wales.

Oblong, rectangular, concentrically ridged and striated, densely radially costated; attaining to three-fourths of an inch.

59. VENERUPIS CUMINGI, Deshayes, P. Z. S., 1853, t. 18, f. 3; Reeve's Mon., t. 3, f. 18.

In the crevices of rocks and hollow stones, Rapid Bay and Encounter Bay! (*Angas*). Type without locality.

Shell ovate; left valve included in the right; concentrically exfoliated, frilled.

60. VENERUPIS OBESA, Deshayes, P. Z. S., 1853, p. 5; Reeve's Mon., t. 3, f. 13.

Encounter Bay (*Angas*); also Victoria (type) and Tasmania.

FAMILY VENERIDÆ.

61. TAPES FABAGELLA, Deshayes, P. Z. S., 1853, p. 10; Reeve's Mon., f. 66; *Venerupis reticulata*, Tenison Woods

Digitized by Google

P. R. S. Tasm. for 1875, p. 159; *Tapes Victoriæ*, T. Woods, P. R. S., Vict., xiv., p. 60, 1878.

In crevices of the limestone floor of Port Adelaide Creek, Aldinga and Holdfast Bays; Encounter Bay; also Tasmania! Victoria! and New South Wales; erroneously credited to New Zealand.

Decussately striated, painted with angular rufous lines on the posterior slope. Length, three-fourths of an inch.

62. TAPES GALACTITES, Lamarck, An. s. Vert., v., p. 599; Reeve's Mon., f. 65.

Southern coast from Eucla to Guichen Bay, and throughout St. Vincent and Spencer Gulfs; also King George Sound (type) and New South Wales.

White, with radial striations. Length, one and a-half inches.

GENUS CHIONE.

(a) *With membranous lamellæ.*

63. CHIONE LAMELLATA, Lamarck (*Venus*), An. s. Vert., v., p. 592; Reeve's Mon. (*Venus*), f. 78.

Hardwick Bay; Port Lincoln; Coffin's Bay, Encounter Bay, and South-East coast; also Victoria, Tasmania (type), and New South Wales.

Ovately-oblong, with about twelve concentric flesh-coloured elevated undulose frills, which are striated on the ventral face. Length, two and a-quarter inches; frills, about ten at that size.

64. CHIONE TIARA, Dillwyn (*Venus*); Reeve, Mon., t. 67, f. 3.

Port Lincoln (*Angas, Bednall!*); Kangaroo Island (*R.T.*); Semaphore (*Fbrwood!*); St. Vincent Gulf (*S. Aust. Mus.!*); also West Australia, Queensland, and Indian Ocean.

Cordately ovate; lamellæ thick, broad, and few.

I have united the species *C. alta*, Sowerby, and *C. tiara*, which Angas has quoted separately for South Australia.

65. CHIONE ROBORATA, Hanley, P. Z. S., 1844, p. 161.

Hog Bay, Kangaroo Island; and Aldinga Bay, St. Vincent Gulf.

Cordately ovate, with numerous, smooth, concentric, thick ridges curved inwards; white, or with pale-pink rays; about one inch long.

(b) *Lamellose, radiately striated; margin of valves crenulated.*

66. CHIONE GALLINULA, Lamarck (*Venus*), An. s. Vert., v., p. 591; *V. lagopus*, Lamarck; *V. Humphreyi*, Donovan; *V. australis*, Sow.; *V. costulata*, Gray.

Digitized by Google

Port Lincoln, Kangaroo Island, Aldinga Bay, Edithburgh, Encounter Bay, South-East coast. Ranges from south-west Australia to New South Wales.

Cordately elliptical, closely covered with thin, erect, short lamellæ, elegantly ornamented with brown angular lines on a whitish ground; length, one and a quarter inches.

The type of *V. gallinula* is from King Island, in Bass Straits, whilst those of *V. lagopus* and *V. australis* are from King George Sound. Deshayes and other authors keep distinct *C. gallinula* and *C. australis*, and both appear in the lists for New South Wales (*Angas*), Tasmania (*T. Woods*), and West Australia; whilst Angas records *V. australis* only for South Australia. The few specimens of *C. gallinula* from the type locality which I have studied are certainly a little higher proportionately than our so-called *C. australis*, but I cannot find any other differential characters. Young shells present much individual variation in respect to outline, strength of the lamellæ, and radial striation, and are inseparable from *C. striatissima*, Sow.

(c) *Concentrically thinly ridged or striated; margin of valves plain.*

67. CHIONE STRIGOSA, Lamarck (*Venus*), An. s. Vert., v., p. 605.

Sandy shores at low tide. Great Australian Bight; Port Lincoln; St. Vincent Gulf. Also King George Sound (type) and Victoria.

Ovately oblong, with wavy ridges coarsely crenulated; more elongated, less oblique, and flatter than its allies; length, one and a half inches.

68. CHIONE APHRODINA, Lamarck (*Venus*), An. s. Vert., v., p. 605. *V. conularis* and *V. Peroni*, Lamarck.

Sandy shores at low tide; Great Australian Bight (St. Francis Isles for type of *V. conularis*); Kangaroo Island (for type of *V. aphrodina*); St. Vincent Gulf; also King George Sound (for type of *V. Peroni*) and Tasmania. (Maria Island, *Lamarck*).

More inflated, and rounder than its allies; transverse ridges plain, broadish, and flat.

69. CHIONE SCALARINA, Lamarck (*Venus*), An. s. Vert., v., p. 599; *V. aphrodinoides*, Lamarck; *V. nitida*, Quoy and Gaimard, t. 84, f. 13, 14, vol. 3, p. 529 (1835).

Sandy shores at extreme low-water mark. Very abundant in Holdfast Bay—used for food and bait for fishing. It ranges from Swan River (*Angas*) and King George Sound! to Tasmania.

Digitized by Google

Somewhat cordate, oblique; transverse ridges acute, slightly elevated, numerous; white, spotted with brown, violet posteriorly.

(d) *Valves smooth.*

70. CHIONE LÆVIGATA, Sowerby *(Venus)*, Thesaurus Conch., t. 159, f. 156—8; *Marcia faba* [Reeve], Angas.

Estuary of the Port Adelaide Creek, of the River Onkaparinga, and of the River Glenelg; Surveyor's Point, St. Vincent Gulf; and the Great Australian Bight. Also Victoria, Tasmania, and New South Wales.

The specimens from the estuary of the Onkaparinga which Angas has identified with *C. faba*, Reeve, are not separable from *C. lævigata* of more southern localities.

Rather inflated, ovate, acuminate posteriorly; colour brown or fawn, often with lighter-coloured rays from the umbones; length, one and three-quarter inches.

71. CHIONE UNDULOSA, Lamarck (*Venus*), An. s. Vert., v., p. 606; *V. variabilis*, Sowerby.

Port Lincoln; Holdfast Bay; Guichen and Robe Bays. Also Shark Bay and King George Sound (type), New South Wales, and North Australia.

Triangularly ovate, white, rayed with angular, undulating, reddish-brown lines or blotches; length, one inch.

72. CIRCE CORRUGATA, Chemnitz. Var. C. CROCEA, Gray; *Cytherea rivularis*, Menke, Moll. Nov. Holl., p. 42.

Port Lincoln; Kangaroo Island; Noarlunga; Port Adelaide Creek. Also West and North Australia, Queensland, and the Indian Ocean.

Depressed, lenticular, with flattened contiguous umbos, surface concentrically corrugated; two inches in the larger diameter.

73. DOSINIA GRATA, Deshayes, Brit. Mus. Cat., p. 10; *D. Diana*, Adams and Angas, Proc. Zool. Soc., 1863, p. 424. Pl. v., fig. 15.

Hardwicke Bay, Spencer Gulf (*Angas*); Hog Bay, Kangaroo Island; Encounter Bay; South-East coast (*Bednall!*). Also Tasmania! (type).

Orbicular, white, gibbous, very smooth in the umbonal region; concentric liræ depressed, crowded, microscopically very closely radiately striated; length, one and three-quarter inches.

D. Diana was founded on South Australian specimens which I fail to separate from Tasmanian examples of *D. grata*.

Digitized by Google

74. Dosinia crocea, Deshayes, Brit. Mus. Cat., Conchifera, p. 10.

Port Adelaide Creek; Aldinga Bay and Surveyor's Point, in St. Vincent Gulf; Port Lincoln; South-East (*Bednall!*); Flinders Island (*Deshayes*).

Orbicular, depressed, with close, regular, erect, thin, concentric lamellæ; white, sometimes rufous spotted; lunule rufous red; length, one and a half inches.

75. Meroe Aliciæ, Adams and Angas (*Sunetta*), Proc. Zool. Soc., 1863, t. 37, f. 18.

Cape Spencer, Southern Yorke Peninsula (*J. G. McDougall!*); Encounter to Guichen and Robe Bays; also Victoria (*Bednall!*).

Ovate cordate, smooth; white, yellowish, or red; sometimes blotched with purplish-red; margin of valves finely crenulated. Length, one inch.

76. Cytherea Diemensis, Hanley, Proc. Zool. Soc., 1844, p. 110; *C. multistriata*, Römer's Mon., Reeve's Mon.

Dredged in life from ten fathoms off Holdfast Bay (*S. Aust. Mus.!*); also Tasmania (type).

Oblong-ovate, fulvous, rayed with ashy purple. Length, one and a-half inches.

77. Cytherea rutila, Sowerby, Thes. Conch., t. 163, f. 205; *Mercenaria paucilamellata*, Dunker; *Callista Victoriæ*, Tenison Woods, P. R. S. Tasm. for 1875, p. 159.

Sandy exposed coasts, south from Encounter Bay; also Victoria, Tasmania, and New South Wales.

Very solid, more trigonal than the last, usually with a few thick small lamellæ anteriorly; chesnut, coloured with broad rays of lighter tint. Length, two inches.

Family Cycladidæ.

78. Sphærium Macgillivrayi, E. A. Smith, Proc. Lin. Soc., xvi., t. 7, f. 34, p. 305, 1882.

Tatiara Creek, Bordertown (*Tomsett!*); also Penrith, N. S. Wales (type).

79. Pisidium Etheridgei, E. A. Smith, loc. cit., t. 7, f. 35, p. 306.

Valley Lake, Mount Gambier; also Yan-Yean Reservoir, Victoria (type).

80. Corbicula Angasi, Prime, Journ. de Conch., xii., p. 151, t. 7, f. 6, 1864; *C. rivina*, Clessin.

River Murray (type) and Lake Alexandrina, and in most of the perennial streams within the drainage area of the Lower

Digitized by Google

Murray. Rivers Onkaparinga, Torrens, and Para. Also Muddy Creek, Hamilton, Victoria (*R.T.*).

81. CORBICULA DESHAYESI, E. A. Smith, Proc. Lin. Soc., xvi., t. 7, f. 28-29, p. 303.

Dead shells only on the north-east shore of Lake Alexandrina. Types from Victoria R. and Port Essington, North Australia.

82. CORBICULA DESOLATA, Tate, *antea*, p. 67, t. 4, f. 11.

Cooper's Creek at Innamincka (*James McLeod!*).

FAMILY CARDIIDÆ.

83. CARDIUM PULCHELLUM, Gray in Dieffenbach's N. Zealand, ii., p. 252 ; id. Reeve, Mon., t. 8, f. 42.

Dredged in life from 6 fms. off the Orontes bank in St. Vincent Gulf ; Kangaroo Island (*S. Aust. Mus.!*). Also Victoria, Tasmania, New South Wales, and New Zealand.

Finely radially costated, posterior slope with sharp tubercles, whitish with orange-coloured rays. Length, seven-sixteenths of an inch.

84. CARDIUM TENUICOSTATUM, Lamarck, An. s. Vert., vi., p. 5 (1819); Reeve's Mon., f. 50.

From the Head of the Great Bight to Port Lincoln ; Spencer and St. Vincent Gulfs, throughout the temperate waters of Australia ; also at the Philippines ; New Holland and Timor (*Lamarck*).

Thin, ventricose, slightly oblique, rayed with numerous fine ribs, surmounted by epidermal frills ; flesh-coloured waves on a white or yellowish ground, umbones purple. Length, two inches.

85. CARDIUM CYGNORUM, Deshayes, P. Z. S., 1854, p. 331.

Same South Australian localities as the last, though much less common ; also Swan River (type) and Tasmania.

Ovate, depressed, slightly oblique ; about 40 narrow elevated radial costæ, crenulate on the sides ; white, yellow at the margins, spotted with reddish-brown. Length, one and a-half inches ; height, one and three-quarter inches.

86. CARDIUM FOVEOLATUM, Sowerby, Conch. Illustrations, f. 65.

Dead shells at Point Riley, Wallaroo Bay; also West Australia (type).

Similar to the last; very solid, not oblique, narrower, and with 24 costæ.

FAMILY CHAMIDÆ.

87. CHAMA SPINOSA, Broderip, Trans. Zool. Soc., i., t. 38, f. 8, 9 ; *C. fragum* [Reeve], Angas.

Digitized by Google

On rocks beyond low tide, Fowler's Bay to Port Lincoln; Spencer and St. Vincent Gulfs; also New South Wales and Lord Hood's Island (type).

Concentrically frilled with rows of short irregular imbricate spines; white, tinged with red.

88. CHAMA CRISTELLA, Lamarck (?), An. s. Vert., vi., 96.

Same localities as the last species, to which it bears a strong resemblance; concentric lamellæ, with foliar expansions. Indian Ocean (*Lamarck*).

89. CHAMOSTREA ALBIDA, Lamarck, An. s. Vert., vi., p. 96.

Port Lincoln; Kangaroo Island; St. Vincent Gulf; South-East coast; also Tasmania, New South Wales, and New Zealand.

Right valve very convex, keeled, *attached* by its anterior side; beaks anterior subspiral; white, smooth; left valve flat; about two inches in diameter.

FAMILY LUCINIDÆ.

90. LUCINA FABULA, Reeve's Mon., t. 11, f. 69 (1850).

Streaky Bay; Waurailtie, Spencer Gulf; Surveyor's Point, St. Vincent Gulf; Encounter Bay. [Polynesia, *Reeve.*]

Shell flat, concentric ridges ending in slight serratures on the post-dorsal margin. Length, a little exceeding half an inch.

91. LUCINA TATEI, Angas, Proc. Zool. Soc., 1878, t. 54, f. 15.

Fowler and Streaky Bays, Port Lincoln, St. Vincent Gulf, and South-East coast.

Quadrately ovate, front dorsal margin deeply excavated, concentrically and radiately ridged; length, three-eighths of an inch.

92. LUCINA CONCENTRICA, Adams & Angas, Proc. Zool. Soc., 1863, t. 37, f. 19.

Streaky Bay, Port Lincoln, Waurailtee in Spencer Gulf, Edithburgh, Holdfast Bay.

Orbicular, subglobose, with thin erect distant concentric ridges, radially striated; length, nearly one inch.

93. LUCINA CRASSILIRATA, Tate, *anteà*, p. 67, t. 4, f. 2.

Streaky Bay.

Orbicular, subglobose, with thick concentric ridges; length, about quarter of an inch.

94. LUCINA QUADRISULCATA, D'Orbigny, Voy. Amer. Merid. Moll., Cuba, t. 27, f. 34, 36; *L. Cumingi*, A. Adams & Angas, P. Z. S., 1863, t. 37, f. 20.

Digitized by Google

St. Vincent Gulf (type specimen, *Angas*); Middleton (*R. H. Pulleine!*); and South-East coast.

Shell orbicular, divaricately ridged.

The South Australian shell has been merged by several authors into *L. dentata*, Wood, but E. A. Smith in Moll. Challenger Exped. has very properly shown the invalidity of such association. On the authority of Mr. Cook (Ann. and Mag. Nat. Hist., 1886), *L. Cumingi* is made a synonym with *L. quadrisulcata*, and has a wide geographic range.

95. LORIPES ICTERICA, Reeve (*Lucina*), Mon., t. 10, f. 60.

Throughout South Australian waters, extending to New South Wales.

Globose, white, finely concentrically and radiately striated.

96. CRYPTODON GLOBOSUM, Forskal, Descript. anim. Egypt; *Lucina ovum*, Reeve, Mon., t. 5, f. 21.

Port Lincoln; Salt Creek, and Holdfast Bay in St. Vincent Gulf; Encounter Bay. Somewhat rare in a living state, but abundant in the Pleistocene beds, Port Adelaide. Also New South Wales, Queensland, Philippines, Red Sea.

Orbicular, swollen, thin, about one inch long.

FAMILY UNGULINIDÆ.

97. DIPLODONTA GLOBULARIS, Lamarck (*Lucina*), An. s. Vert., v., p. 544; *Lucina globularis*, Reeve, Mon., t. 9, f. 23.

Fowler's Bay; St. Vincent Gulf; Encounter Bay.

The Lamarckian type is from King George Sound; and the species also occurs in New Zealand, as recorded by Lamarck.

Shell globose, inflated, subequilateral; hinge line straight, rounded at both ends.

98. DIPLODONTA TASMANICA, Tenison-Woods, Proc. Roy. Soc., Tasm., for 1876, p. 158.

Holdfast Bay. Also Tasmania!

Shell quadrately orbicular; anterior side short, its margin rapidly descending; hinge line straight, posterior side wider and depressed; length and height, from one-third to an inch.

FAMILY ERYCINIDÆ.

99. MONTACUTA MERIDIONALIS, Tate, *anteà*, p. 68, t. 5, f. 4.

Shell sand, Aldinga Bay and Port Lincoln.

Ovately orbicular, thin, transparent, rather inflated, concentrically finely striated; length, three-eighths of an inch.

100. KELLIA SOLIDA, Angas, Pro. Zool. Soc., 1877, p. 176, t. 26, f. 25; *Mysella anomala*, Angas, P. Z. S., 1878, p. 870 (*non.* Angas, 1877).

Digitized by Google

Shell sand. St. Vincent Gulf; Fowler's Bay. Also New South Wales (*Angas*).

Quadrately ovate, translucent, shining, anterior side short, posterior extremity roundly truncate; length, three-eighths of an inch. Left valve with one conical tooth in front of the cartilage pit, with a lamelliform tooth close to it; there is a rather distant lamelliform tooth on the posterior side. Right valve with a laminar tooth in front of the cartilage notch, and a similar one posteriorly, but more distant.

This species resembles externally *Mysella anomala*, with which Angas confounded South Australian specimens of *K. solida* sent to him by me for identification, under which name it appears in the above-quoted paper.

101. KELLIA ROTUNDA, Deshayes (*Erycina*), Proc. Zool. Soc., 1855, p. 181; E. A. Smith, Moll. Challenger Ex., t. 21, f. 5, p. 202.

Dredged in shallow water and cast up, Holdfast, Aldinga, and Encounter Bays. Extends to Queensland.

Shell somewhat globose, inflated, having much the form of *Diplodonta globularis*; dentition as in *K. solida*, but the cardinal tooth in the left valve is sometimes obsolete.

102. KELLIA ANGASIANA, Tate, *anteà*, p. 68, t. 5, f. 7.

Shell sand. Holdfast Bay.

Minute, triangularly oval, sculptured with raised concentric threads.

103. PYTHINA DESHAYESIANA, Hinds.

Shell sand, Fowler Bay to Port Lincoln, Spencer and St. Vincent Gulfs; Encounter Bay and South-East coast; also Tasmania.

Roundly-oblong, divaricately ribbed, marginal ribs lamellose; umbonal area smooth.

104. PYTHINA TASMANICA, Tenison Woods, Proc. Roy. Soc. Tasm. for 1875, p. 162. Plate v., f. 12.

Fowler and Streaky Bays; St. Vincent Gulf; also King Island, Bass Straits (type).

Suborbicular, divaricate ribs, latticed with concentric sulcations.

105. PYTHINA GEMMATA, Tate, Trans. Roy. Soc. S. Aust., 1879, t. v., f. 8.

Shell sand, Fowler Bay; Streaky Bay.

Ovately-oblong, sculptured with divaricating granulose plicæ. Length, about one-tenth of an inch.

106. LEPTON AUSTRALE, Angas, Proc. Zool. Soc., 1878, t. 54, f. 14, p. 863.

Digitized by Google

Holdfast Bay and Salt Creek, St. Vincent Gulf; Streaky Bay; also in the Pleistocene shell-limestone of the Port Adelaide Creek, not uncommon.

Quadrately orbicular, flat, umbo produced, acute, a little in front of the centre; microscopically sculptured with concentric and radial striæ; attains to three-eighths of an inch long.

107. LEPTON TRIGONALE, Tate, Trans. Roy. Soc. S. Aust., 1879, t. 5, fig. 5.

Fowler and Streaky Bays, Port Lincoln, St. Vincent Gulf.

Trangularly ovate, with finely shagreen-sculpture on the sides, umbones produced, small, acute.

108. LEPTON OVATUM, Tate, *anteà*, p. 68, t. 5, f. 11.

In shell sand, Holdfast Bay.

Minute, ovate-oblong, umbones obtuse, oramented with distant growth lines and very minute granules.

109. LASÆA RUBRA, Montague.

Between tide marks in rock crevices and among mussels, &c.; throughout our coast line.

This cosmopolitan species has a host of synonyms, and the following specific names have been established on Southern examples:—*Poronia australis*, Sow., T. Woods, Angas; *Poronia purpurata*, *scalaris*, *Parreysi*, Philippi.

A minute cordately-ovate shell, varying from broadly concentrically ribbed to almost smooth; reddish to white, red stained along the hinge line.

110. MYSELLA DONACIFORMIS, Angas, Proc. Zool. Soc., 1878, p. 963. t. 54, f. 13.

Fowler, Streaky, and Laura Bays, Great Australian Bight; St. Vincent Gulf; also King George Sound!

A cuneiform, somewhat solid shell, about one-fourth of an inch long.

The genus Mysella (*M. anomala*, Angas, op. cit., 1877) was placed by its author in the family Tellinidæ, but the absence of a pallial sinus, the internal cartilage, and the dentition bring it in close relation to *Montacuta*.

111. SCINTILLA LUNATA, Tate, *anteà*, p. 69, t. 4, f. 8.

Creeping on rocks at extreme low tide, Edithburg, Yorke Peninsula (*McDougall*).

Ovate-lanceolate, pellucid, compressed.

FAMILY SOLEMYIDÆ.

112. SOLEMYA AUSTRALIS, Lamarck, An. s. Vert., v., p. 489.

St. Vincent Gulf; occasionally cast up in considerable numbers at Holdfast Bay; also King George Sound (type).

Digitized by Google

Cylindrical, gaping at each end, covered with a dark brown, horny epidermis extending beyond the margins.

Family Crassatellidæ.

113. Crassatella castanea, Reeve, Mon., t. 1, f. 3.

In deep water in the Port Lincoln district; Cape Jaffa, South-East coast, dead shell only (*W. T. Bednall!*). New Holland (*Reeve*).

Ovately triangular, chesnut-coloured epidermis, umbones smooth; length, attaining to four inches.

Family Astartidæ.

114. Cardita rosulenta, Tate, *anteà*, p. 69, t. 5, f. 3.

Deep water, Encounter Bay and Backstairs Passage.

Trapezoid, with 22 narrow scaly ribs, spotted with red; length, about one inch.

115. Cardita obliquissima, Tate, *anteà*, p. 70, t. 5, f. 9.

Dead shells dredged from 22 fathoms, Encounter Bay (*Pulleine!*).

Minute, very oblique, concentrically sulcated, and radially ridged on the narrow angulated posterior side.

116. Mytilicardia crassicosta, Lamarck (*Cardita*), An. s. Vert., vi., p. 24; id., Reeve, Mon., t. 2, f. 7.

Throughout South Australian waters. Also West Australia and the Philippines.

Oblong, with radiating costæ, which are raised into lamellar arched scales; colour red or pink, occasionally yellow; length, two inches.

117. Mytilicardia concamerata, Chemnitz (*Chama*); *Cardita concamerata*, Reeve, Mon., t. 9, f. 42; *Thecalia macrotheca*, A. Adams and Angas, P. Z. S., 1864, p. 39.

Under stones at low tide, Rapid Bay (*Angas*). Mr. E. A. Smith, who has compared the type of *Thecalia macrotheca* with South African specimens of this well-known species, cannot detect the slightest difference.

Ovate-oblong, radiately ribbed, a cup-shaped appendage within each valve.

118. Carditella infans, E. A. Smith, Mollusca, Challenger Exped., t. 15, f. 10, p. 218.

Rotund, solid; rose-coloured; eighteen radiating costæ separated by very narrow deep grooves, costæ with crowded transverse tubercles. The type specimens are whitish, and were obtained in 28 fathoms, south of Papua. A left valve only, dredged in 22 fathoms, Encounter Bay.

Digitized by Google

119. CARDITELLA SUBTRIGONA, Tate, *anteà*, p. 70, t. 4, f. 10.

Cast up, Streaky Bay.

Ovate-subtrigonal, with fourteen broadish radiating costæ; about one-fourth inch long.

FAMILY UNIONIDÆ.

120. UNIO STUARTI, A. Adams and Angas (*Alasmodon*), P. Z. S., 1863, p. 417; *Anodon Stuarti*, Sowerby, in Reeve, Mon., t. 34, f. 136, 1870.

Various freshwater streams in the Lake Eyre Basin, as at Mount Margaret! the type locality (*Waterhouse*); at Umbum, 40 miles south from Peake!; Cooper's Creek, at Innamincka! Also Newcastle Waters (*Waterhouse!*)

An elongate-ovate shell, about twice as long as wide; posterior side long, obliquely subtruncate; hinge line straight. Length, four inches.

121. UNIO EVANSI, A. Adams and Angas (*Alasmodon*), P. Z. S., 1864, p. 39; id., Reeve, Mon., t. 56, f. 285, 1867.

In the actual bed of the River Murray, and therefore apparently rare, I have taken it several times from the stomach of the "Murray cod."

A thick elongate-ovate shell, about twice as long as wide, with the dorsal line arched, attenuated and somewhat angulated posteriorly. Length, four inches.

122. UNIO DEPRESSUS, Lamarck, Ans. s. Vert., vii., p. 79; *U. mutabilis*, Lea, Obs. on Unio, vii., p. 66, t. 38, f. 167.

Very abundant in the lagoons bordering the River Murray and in Lake Alexandrina; also New South Wales.

Quadrately-ovate, nearly as broad as long, thin, depressed; hinge line nearly straight, short; truncated posteriorly. Length, from two to three inches.

123. UNIO VITTATUS, Lea, Obs. on Unio, vii., p. 67, t. 39, f. 128; *U. ambiguus*, Philippi.

Rivers Para, Torrens, and Onkaparinga; Scott's Creek, a tributary of the R. Bremer; Mosquito Creek, near Narracoorte; also Queensland.

Ovate-oblong, somewhat thick and inflated; dorsal line arched, somewhat ascending posteriorly; posterior margin roundly truncated. Length, about three inches; breadth, two inches.

FAMILY TRIGONIIDÆ.

124. TRIGONIA MARGARITACEA, Lamarck, An. s. Vert, vi., p. 63; Reeve, Mon., t. 1, f. 3.

Dead shells, Holdfast and Aldinga Bays. Dredged in life

Digitized by Google

from eight fathoms in Encounter Bay (*R. H. Pulleine!*); also Tasmania (type) and New South Wales.

Family Nuculidæ.

125. Nucula micans, Angas, Proc. Zool. Soc., 1878, t. 54, f. 16.

Shell sand, St. Vincent Gulf.

A minute shell, obliquely and triangularly ovate, finely concentrically striated.

126. Leda crassa, Hinds., P. Z. S., 1843, p. 99; id. Reeve's Mon., t. 5, f. 27. *L. Chuva*, Gray in Jukes, Voy. Fly, ii., t. 2, f. 3, p. 360 (1847); id. Reeve, Mon., t. 7, f. 46.

Rare in St. Vincent Gulf, but common as a beach shell in Encounter Bay, dredged in life from deep water by R. H. Pulleine. Extends to Queensland. Gray's types are from Bass Straits.

Elongate oval, ventral margin strongly arched, curved upwards posteriorly to form a rostral prolongation, sculptured with thick flattened ribs.

Family Arcidæ.

127. Arca navicularis, Bruguiere, Reeve's Mon., t. 9, f. 70.

Port Augusta, Spencer Gulf (*R. H. Pulleine!*). Also Victoria (E. A. Smith); Queensland and North Australia!, China and Amboina.

Elongate, trapeziform, umbones high and wide apart, gaping ventrally, ornamented with granular ribs with unequal thick radial ribs on the posterior slope, attaining to one and a half inches long.

128. Barbatia lima, Reeve (*Arca*), P. Z. S., 1844; id. Mon., t. 15, f. 101.

Deep water, St. Vincent Gulf (*Angas*). Also Torres Straits (Voy. Challenger), and Philippines.

129. Barbatia radula, E. A. Smith, Moll. Challenger Exped., t. 17, f. 3, p. 260.

General from the Great Australian Bight to the South-East coast. Also Victoria and Tasmania.

Narrowly oblong, inequilateral, ornamented with numerous slender granulated ribs, and clothed with a brown pilose epidermis, attaining to a length of two inches.

130. Barbatia trapezia, Deshayes (*Arca*), Mag. de Zool.; *Arca lobata*, Reeve, P. Z. S., 1844, and Mon., t. 3, f. 19.

In a subfossil condition at Wallaroo Bay, Victor Harbour, Ardrossan, Aldinga Bay, and Port Adelaide Creek; dead, but

Digitized by Google

apparently fresh, shells on the beach at Streaky Bay, Great Australian Bight. Also Victoria, Tasmania, and New South Wales.

It is one of the most characteristic fossils of the raised beaches along our coastline.

Trapeziform, oblique, gibbous, very thick; radial costæ, rather distant and crenulated; length, two inches.

131. BARBATIA LAMINATA, Angas, Proc. Zool. Soc., 1865.

At several stations in the Great Australian Bight and St. Vincent Gulf.

Oblong, about one inch long and half an inch wide, concentric lamellæ imbricating and frilled.

132. PECTUNCULUS RADIANS, Lamarck, An. s. Vert., vi., p. 54.

Port Lincoln; Encounter Bay; South-East coast (*W. T. Bednall!*). Also Victoria, Tasmania, and New Holland (*Lamarck*).

Orbicular, with flattish, radial ridges, radially substriated and concentrically finely striated.

133. PECTUNCULUS OBLIQUUS, Reeve, P. Z. S., 1843.

Fowler's Bay, St. Vincent and Spencer Gulfs; South-East coast. Also West Australia (type) and Tasmania.

Suborbicular, inequilateral, produced posteriorly, ornament similar to the last, but the radial ridges more elevated and acute; length, to one inch and a quarter.

134. PECTUNCULUS FLABELLATUS, Tenison-Woods, Trans. Roy. Soc., Victoria, xiv., p. 61, 1878; *P. orbicularis*, Angas, P. Z. S., 1879, t. 35, f. 9; *P. Beddomei*, E. A. Smith, Moll. Challenger Expedition., t. 18, f. 1, p. 252.

Dead shells, Hallett's Cove; Ardrossan; Cape Jervis; Wallaroo. Also Victoria and Tasmania (*T. Woods*); Flinders Island (*R. M. Johnston!*); Bass Straits (*Angas; Challenger Exped.*).

Orbicular, thick, with about 25 broad, somewhat depressed radial ribs; colour white, more or less clouded and spotted with fulvous-brown.

135. PECTUNCULUS GRAYANUS, Dunker, Proc. Zool. Soc., 1856, p. 357.

Wallaroo (*Dr Gosse!* and *R. T.*) Also New South Wales.

A thick orbicular shell, smooth, white, with angular streaks and flames of chesnut-brown colour; about two inches in diameter.

135. LIMOPSIS BASSII, E. A. Smith, Moll. Challenger Exped., t. 18, f. 6, p. 256, 1885.

Digitized by Google

Dredged in life from 20 fathoms in Encounter Bay (*R. H. Pulleine!*); cast up at Ardrossan and Edithburg. Also Bass Straits in 38 fathoms (*Challenger Exped.*).

Transversely ovate, oblique, cancellate ornament, reddish-brown, dirty-white or yellowish about the umbos, clothed with a thick pilose epidermis; length, three-fourths inch.

137. LIMOPSIS BELCHERI, Adams and Reeve, Voy. Samarang, t. 22, f. 5; id. McCoy, Pal. Victoria, Decade II., t. 19, figs. 8–9; *L. Tenisoni*, Tenison-Woods, Proc. Roy. Soc., Tasm., 1877; *L. cancellata*, id. 1876 (non. *Reeve*); *L. Macgillivrayi*, Angas, P. Z. S., 1878, p. 871.

Robe and Guichen Bays in a fresh state; dead shells St. Vincent Gulf and Kangaroo Island. Also Port Phillip (*McCoy*); Tasmania (*Tenison-Woods*).

A common fossil in the Pleistocene beds of the Port Adelaide Creek, and in Older Tertiary beds River Murray Cliffs, Muddy Creek near Hamilton, &c.

Orbicular, slightly oblique; radiately ribbed and with wavy, close, concentric lirae; the ligamental pit is much smaller and the hinge teeth (about 24) more numerous than in *L. Bassii*.

138. LIMOPSIS RUBRICATA, Tate, *anteà*, p. 71, t. 5, f. 6.

Dredged in life from 32 fathoms, Backstairs Passage.

A minute shell, radiately finely sulcated, concentrically striate, with four chesnut-coloured rays, covered with a thin light-horn epidermis.

FAMILY MYTILIDÆ.

GENUS MYTILUS.

(a) *With longitudinal furrows.*

139. MYTILUS HIRSUTUS, Lamarck, An. s. Vert., vi., p. 120; id., Reeve, Mon., t. 3, f. 8.

At various stations from the Great Bight to Port Lincoln; Port Broughton and Wallaroo; Kangaroo Island; Port Adelaide Creek; also Tasmania, New South Wales, Japan, and China.

Strongly curvated; dark brown, ornamented with very fine closely-set dichotomous riblets, and covered with long, barbed hairs. Length, two and a-half inches.

140. MYTILUS ROSTRATUS, Dunker, Proc. Zool. Soc., 1856 p. 358.

Great Australian Bight; Edithburg; Encounter and Guichen Bays; also Tasmania (type).

Elongate, nearly parallel sided, attenuated towards the beaks; reddish-purple, ornamented with fine closely-set divaricating riblets. Attains to one and a-half inches long.

Digitized by Google

141. MYTILUS MENKEANUS, Philippi.

Throughout the South Australian coast line, on rocks between tide marks; also King George Sound!

Variable in shape, usually strongly curvated, with uncinate beaks, but sometimes elongated with nearly straight sides, ornamented with a variable number of radial undulating thick granulose ribs; colour, brown outside, purplish within. Length, about one and a-half inches. It is separable from *M. Magellanicus*, Lamarck.

(b) *Surface smooth.*

142. MYTILUS ATER, Frauenfeld, Moll. Novara Exped., t. 2, f. 29, 30; *M. crassus*, Tenison Woods, P. R. S. Tasmania for 1876, p. 157.

Rocky shores between tide marks, St. Vincent Gulf; also Tasmania (*T. Woods*) and New Zealand! (*Novara Exped., Hutton*, &c.).

Oblong, black, with very tumid umbones. Length, about one inch.

143. MYTILUS CHORUS, Molina; *M. latus*, Lamarck, An. s. Vert., vi., p. 122 (*non.* Chemnitz).

On the keel of the hulk Fitzjames moored in Largs Bay (*Port Adelaide Mus.!*). Probably introduced to this locality from Port Phillip!, where the species is common, and where also the hulk was a derelict for several years; Guichen Bay (*R. H. Pulleine!*); also Tasmania, New Zealand, and Chili.

Oblong-oval, dilated and compressed behind, covered with a dark olive-brown shining epidermis, with a few scattered long hairs set in a white calcareous disc, interior bluish-white; attaining to four inches long.

144. MODIOLA AUSTRALIS, Gray in King's Coasts of Australia, ii., p. 477, 1827; id. Reeve, Mon., t. 5, f. 21. *M. tulipa, var.*, Lamarck, An. s. Vert., vi., p. 111, 1819. *M. areolata*, Gould, U. S. Ex. Ep. xii., p. 452, f. 562.

Beyond low tide throughout South Australian waters. Also Tasmania, New South Wales, and New Zealand. New Holland (*Lamarck*).

Ovately oblong, anterior side very short, posteriorly broadly dilated, convex in the middle; yellow chesnut; adult shells bearded towards the margin; length to three inches.

145. MODIOLA ALBICOSTA, Lamarck, An. s. Vert., vi., p. 111.

Port Elliot (*W. T. Bednall!*). Also Tasmania (*T Woods*), Timor, Indian Ocean, and New Holland (*Lamarck*).

Smooth, shining, dark chesnut with darker rays; attaining to two and a half inches.

Digitized by Google

146. Modiola semivestita, Dunker, Mal. Bl. xviii., p. 173, 1871. *Perna flavida*, Angas, P. Z. S., 1865, p. 653 (*non* Dunker). Plate 5, figs. 16*a*—16*b*.

Nesting in mud between tide-marks, Port Adelaide Creek, and elsewhere in St. Vincent Gulf; Laura Bay on the west coast. Also King George Sound!, St. Vincent Gulf (*Dunker*).

Narrowly oblong, with a chesnut-brown shining epidermis, folds of growth conspicuously raised; length three-quarters of an inch.

I fail to recognise the woolly investiture which Dunker describes as clothing the shell, and think the author has mistaken for it the raised epidermal laminæ encrusted with the foreign matter of its burrow.

147. Modiolaria barbata, Reeve, Mon. Lithodomus, t. 5, f. 27; *Lithodomus laniger*, Reeve, op. cit., f. 30; *Modiolaria barbata*, Angas, P. Z. S., 1867, t. 44, f. 12, p. 911.

Streaky, Fowler, Aldinga, and Holdfast Bays. Also New South Wales (type).

Oblong-ovate, with the epidermis long thick and fibrous posteriorly; length about half an inch.

148. Modiolaria Cumingiana, Reeve, Mon. Modiola, t. 9, f. 63, 1857; *Lanistina nana*, Dunker, P. Z. S., 1856, p. 365; *Modiola nana*, Reeve, Mon., t. 10, f. 69; *Crenella* (*Modiolaria*) *Adolphi*, Dunker, Mal., xviii., p. 173, 1871.

Throughout South Australia, living on sponges, and amidst the parasitic growth on oysters and pinnæ. Extends around the east coast to Port Darwin.

Oblong-oval, inflated; colour, brown, yellow, or in the young stage green mixed with brown. Attaining to a length of one inch.

Lanistina nana, founded on specimens in the Cumingian collection from Port Lincoln, is evidently the fry of *M. Cumingiana*; the rufous variegation and pellucidity which charaterises the early stage of growth are lost in aged examples.

Crenella Adolphi, of the same author, the type of which is from St. Vincent Gulf, seems in no way to differ, so far as description admits of forming an opinion, from *M. Cumingiana*.

149. Modiolaria Paulucciæ, Crosse and Fischer (*Crenella*), Journ. de Conchy., 1863, p. 89, t. 1, f. 8.

Among Zosteræ, Fowler, Denial, and Laura Bays, on the west coast; Spencer and St. Vincent Gulfs.

Oblong-ovate, depressed; broad posteriorly, there ornamented with broad, distant radial ribs; varying in colour from yellow, brown, to bright green, sometimes painted with undulose purplish-brown markings. Length, half an inch.

Digitized by Google

150. Malleus vulsellatus, Lamarck, An. s. Vert, vi., p. 145; *M. albus*, Lamarck; *M. normalis*, Lamk.; *Ostrea regula*, Forskal.

Buried in sand in a few fathoms water, St. Vincent Gulf; Port Lincoln; dead shells, Fowler's Bay, Wallaroo Bay; widely diffused in Australia; Timor, China, &c., to the Red Sea.

151. Pinna inermis, Tate, *anteà*, p. 71, t. 4, f. 5; *P. Zeylanica*, Angas, P. Z. S., 1865, p. 655 (*non* Gray).

Partially buried vertically in mud or sand in a few fathoms water, St. Vincent Gulf, and general from Eucla to the South-East coast.

This shell, locally known as "razor-fish," is wedge shaped, somewhat roundly acuminate posteriorly, and otherwise differs from *P. Zeylanica* by the absence of scaly ribs. Attains to a length of about eighteen inches.

152. Vulsella ovata, Lamarck, An. s. Vert., vi., p. 222; *V. Tasmanica*, *V. limæformis*, and *V. rudis*, all of Reeve, Mon. Vulsella.

Immersed in sponge from shallow water to 32 fathoms; common throughout the whole coast line; also West Australia, Tasmania, and New South Wales.

Very variable in shape, pale horn coloured; concentric liræ, fringed with minute flattened scales.

153. Avicula Georgiana, Quoy and Gaimard, Zool. Voyage Astrolabe, vol. 3, p. 457, t. 77, f. 10–11, 1835; *A. scalpta*, *A. pulchella*, *A. rutila*, and *A. punctulata*, all of Reeve, Mon. Avicula. Possibly *A. papilionacea*, Chemnitz.

Affixed to seaweed. Very general. Extends from King George Sound (*Quoy* and *Gaimard*) to New South Wales. Locally called "butterfly shells."

The above-quoted species-names of Reeve have been founded on individual variations in colour and colour markings.

Transparent, varying in colour from pellucid white, brown, green, with or without coloured rays or spots; length, about one inch.

154. Meleagrina margaritifera, Linnæus (*Mytilus*), Syst. Nat.; Lamarck, An. s. Vert. vi., p. 151.

"Deep water, Spencer Gulf, Coffin Bay, and the Great Australian Bight. This is the 'pearl oyster,' a species generally distributed throughout the Indo-Pacific marine molluscan province" (*Angas*). A very rare species, I have seen only one South Australian example, and that young, in the cabinet of Mr. Bednall.

Digitized by Google

FAMILY PECTINIDÆ.

155. PECTEN ASPERRIMUS, Lamarck, An. s. Vert., vi., p. 174; id. Reeve, Mon. Pecten., t. 20, f. 5; *P. australis*, Sowerby, Thes. Conch., p. 76; id. Reeve, t. 25, f. 103.

On a soft bottom, at a depth of a few fathoms. Throughout the whole length of our coastline. Also West Australia (*Sowerby*), Tasmania (*Lamarck*), New South Wales, New Zealand, and Gulf of Suez (Vaillant, *J. de Conchyl.*, 1865, p. 112).

About 30 radial ribs, flanked on each side by a smaller one, all studded with small spinous scales; colour yellow, orange, brown, scarlet, or purplish; about two inches diameter.

156. PECTEN PULLEINEANUS, Tate, *anteà*, p. 73, t. 4, figs. 1*a–b*.

South-East coast (*R. H. Pulleine!*)

Thirty-three simple similar ribs crossed by close-set continuous lamellæ; about one inch diameter.

157. PECTEN BEDNALLI, Tate, *anteà*, p. 73, t. 4, figs. 3*a–b*.

Aldinga Bay (*W. T. Bednall!*).

Twenty-four groups of two or three subequal ribs with quincuncially-arranged depressions in the interspaces; about one inch diameter.

158. PECTEN BIFRONS, Lamarck, An. s. Vert., vi., p. 164; id. Reeve, Mon., t. 12, f. 45.

Inhabits at about two to six fathoms, and occurs throughout our coast-line reaching to Tasmania. New Holland (*Lamarck*).

Depressed, slightly inequivalve and inequilateral, with about seven principal ribs and numerous radial riblets, with a shagreen-like sculpture between them; attaining a diameter of about three inches.

159. PECTEN FUMATUS, Reeve, Mon. Pecten, t. 7, f. 32. VAR. ALBUS, Tate, Proc. Roy. Soc., Tasm., 1886.

Syn.:—*Vola laticostata*, Angas, P. Z. S., 1865, p. 656 (*non.* Gray); *Pecten bifidus*, Menke, Moll. Nov. Holl., p. 35, 1843; id. Philippi, Neu. Conch., Vol. 1, p. 6, t. 2, f. 6, 1845 (*non.* Münster).

Inhabits with the last extending from Fowler Bay to Port Lincoln and St. Vincent Gulf. Menke's shell is from West Australia.

Right valve deeply convex, sixteen convex ribs about as wide as the furrows, white inside and out; left valve flat, whitish with pink ribs; attaining to a diameter of three and a half inches.

160. LIMA MULTICOSTATA, Sowerby, Thes. Conch.; id. Reeve, Mon., t. 1, f. 4; *Radula lima* (Linne), Angas, P. Z. S., 1865, p. 656.

Digitized by Google

Chiefly in sponge at shallow depths; Great Australian Bight to Port Lincoln, Spencer and St. Vincent Gulfs, Guichen Bay. Throughout Australia and the Indo-Pacific region.

Oblique, with about 30 scaly ribs; attaining to two inches in the longer diameter.

161. LIMA ANGULATA, Sowerby, Thes. Conch., p. 86, t. 22, f. 39; id. Reeve, Mon., t. 3, f. 13.

Living at two to six fathoms in St. Vincent Gulf and at Port Lincoln. Also New South Wales, New Zealand, New Caledonia, Philippines, and Panama.

Obliquely subtrigonal, ventricose, very finely radiately ribbed; attaining to nearly one inch in the longer diameter.

162. LIMA BULLATA, Born; id. Reeve, Mon., t. 1, f. 2; *L. Strangei*, Reeve, Mon., t. 3, f. 15; *L. Japonica*, A. Adams, P. Z. S., 1863, p. 509; Reeve, Mon., t. 5, f. 21.

Wauraltee Island and Wallaroo in Spencer Gulf, St. Vincent Gulf, Guichen Bay. Also Tasmania, New South Wales, and Queensland, extending to New Zealand, the Philippines, and Japan.

This species belongs to the section Limatula, having equilateral, ovate valves; rayed with numerous strong, rather sharp ribs. Attaining to about one and a-quarter inch in the longer diameter.

163. LIMEA AUSTRINA, Tate, *anteà*, p. 73, t. 4, f. 7.

Dead shells dredged in 32 fathoms in Backstairs Passage, and in 22 fathoms in Encounter Bay; also in Pliocene strata, Limestone Creek, R. Glenelg, Victoria.

A small subovate, equilateral shell, ornamented with twenty radiating nodulose ribs.

FAMILY SPONDYLIIDÆ.

164. SPONDYLUS TENELLUS, Reeve, Mon., t. 18, f. 67.

Not uncommon from Eucla to Port Lincoln, St. Vincent and Spencer Gulfs; Guichen Bay; also in Tasmania and in the Pacific.

Ovate, radiately ridged, bearing foliaceous or spinous expansions, the interspaces with crowded radial riblets, covered with imbricating scales. Length, two inches.

FAMILY ANOMIIDÆ.

165. PLACUANOMIA IONE, Gray, Proc. Zool. Soc., 1849, p. 123; id., Reeve, Mon., t. 2, f. 6; Tate, T. R. Soc. S. Aust, 1885, t. 5, f. 7, p. 101.

Not uncommon in St. Vincent Gulf, affixed to Pinnæ; cast

Digitized by Google

up South-East coast; also Tasmania, New South Wales, and New Zealand. Upper beds of the Older Tertiary, River Murray cliffs, at Aldinga and Hamilton; Pliocene beds at Limestone Creek, R. Glenelg.

Irregularly orbicular, flat, thin, ornamented with imbricating scaly laminæ, and radial threads or ridges; diameter, two inches.

FAMILY OSTREIDÆ.

166. OSTREA ANGASI, Sowerby, in Reeve's Mon., t. 13, f. 27.

Ranges from low tide to a few fathoms; Davenport Creek, in the Great Bight; Coffin's Bay and Port Lincoln; Spencer and St. Vincent Gulf; Kangaroo Island; also Tasmania, New South Wales, Port Darwin, and New Zealand. In Pliocene strata, Limestone Creek, and Ascot Heath, in West Victoria.

This species, which is the common "Port Lincoln oyster" of the Adelaide markets, is the southern analogue of the European *O. edulis*, under which species name, or as a variety, it has been more frequently quoted by conchological writers. The "Sydney rock-oyster" (*O. glomerata*, Gould), so largely imported as food, is not indigenous in our waters, but it has lately been introduced, so I have been informed, to the Port Lincoln district.

CLASS PALLIOBRANCHIATA.

1. WALDHEMIA FLAVESCENS, Lamarck, An. s. Vert., [vi., p. 246; Reeve, Mon. Terebratula, t. 2, f. 1.

Attached to rocks and the bases of the large seaweeds beyond low tide, Fowler Bay, St. Vincent and Spencer Gulfs, Encounter Bay. Also Victoria, Tasmania, and New South Wales.

Ovate, inflated, with a pentagonal outline and broad radial ridges; length, one inch.

2. TEREBRATELLA CANCELLATA, Koch.

Dredged in life from 32 fathoms in Backstairs Passage; dead shells from 20 fathoms, Encounter Bay (*R. H. Pulleine!*) Also New South Wales (*Brazier*), West Australia (*Dall*), and Tasmania (*Challenger Exped.*).

Shell ovate, rather depressed, with a pentagonal outline, ornamented with numerous radiating riblets; length, three-fourths of an inch.

3. MEGERLIA WILLEMOESI, Davidson, Brach. Challenger Exped., t. 4, f. 1–3, p. 51.

One dead shell from 22 fathoms in Encounter Bay (*R. H. Pulleine!*)

A minute, inflated, smooth, ovate shell of a cochineal-red

Digitized by Google

colour. The identification is not complete, as the example has lost its loop: it is certainly not *Magasella Cumingi*. The type is from Twofold Bay, New South Wales.

4. KRAUSSINA LAMARCKIANA, Davidson, P. Z. S., 1852, p. 80, t. 14, f. 22–33; id. Reeve, Mon. Terebratula, t. 9, f. 34.

Shell sand, Fowler's and Holdfast Bay. Also New Zealand, Tasmania, and New South Wales.

Shell very small, squarely rounded, depressed, radiately ridged, conspicuous by its straight hinge line and its large broadly-triangular foramen.

5. ORBICULA TENUIS, Sowerby, in Reeve's Mon., t. 1, f. 5.

Port Lincoln and Chili (Cuming Coll.).

Digitized by Google

Description of a supposed New Species of Phasmidæ.

By J. G. O. Tepper, F.L.S., &c.

[Read August 3, 1886.]

Plate VI.

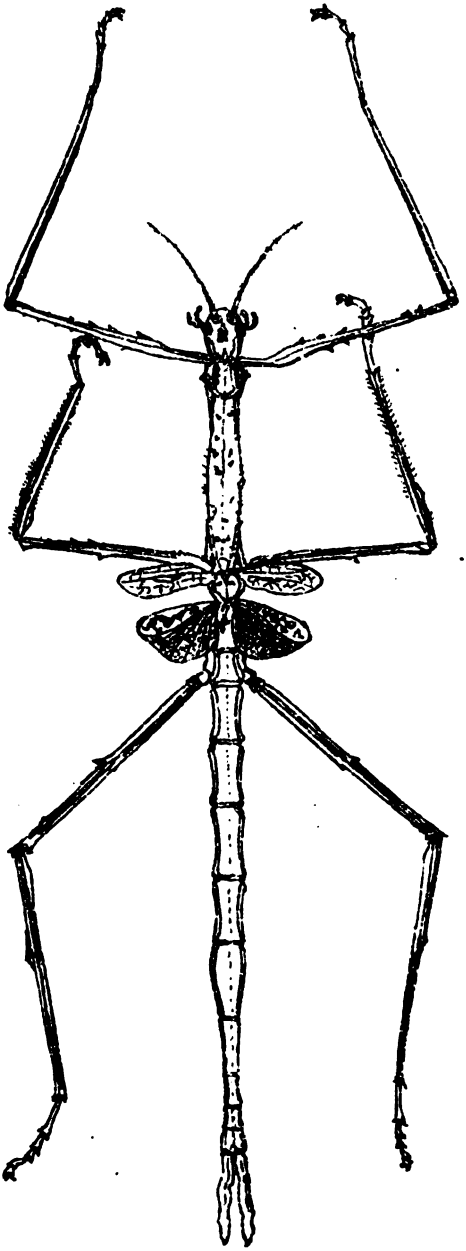
Several very remarkable examples of Phasmidæ with rudimentary wings were presented in the course of the last twelve months to the Adelaide Museum. The perfect insect was captured at Mount Lofty by Mrs. Stirling, and another specimen was obtained by Mr. Guest, of Balhannah, while I collected two specimens in the nymphal condition.

In consulting the available literature I could find no mention of this large insect. I therefore venture to lay a description before the Society, and attach a provisional name, deferring the species to Westwood's genus *Lopaphus*, although one of the generic distinctions does not fit, viz., "tegmina much smaller than the wings." The one before us has the first as long or longer than the latter.

Lopaphus macrotegmus. *Spec. nov.* Plate VI. (nat. size of a rather small specimen).

Body long, slender, dull brown, similarly winged in both sexes; head elongated, broader in front, forehead slightly wrinkled; eyes prominent; antennæ filiform, first two joints dilated, many-jointed, about four or five times the length of the head; mesothorax five times longer than the prothorax, with a few small tubercles; metathorax about half as long; abdomen cylindrical, tapering after fourth segment, last two very short; terminal foliolets longer than any segment, rather broad, rounded at the tip; operculum conspicuous, rising from seventh segment, not extending beyond the body; legs straight, slender, mottled grey, first pair longest; femora dentated conspicuously above, less so beneath, inner angle smooth; tibia straight, smooth; second pair shortest; femora with one (or two) teeth above near the middle, four or five beneath; tibia twin tooth above, nearer the elbow joint, and two small teeth near the wrist beneath; third pair intermediate; femora one small tooth in the middle and another near elbow above and several beneath, tibia with a double tooth above; tarsi long, first joint longer than half the

Digitized by Google



W.J.CHIDLEY DEL

Digitized by Google

Digitized by Google

whole, fourth very small; tegmina as long or longer than the wings; the latter rudimentary, anterior part pale brown with a few irregular narrow black bars; posterior part black, translucent. Length of body, about 5½ in.; head, about ¼ in.; forelegs, about 3¾ in.; middle pair, about 2¾ in.; tegmina, about ⅜ in.; wings, about ⅐ in.; foliolets, about ⅛ in. The above refers to the female, the male being slightly smaller. In the nymphal form the colour is greenish, but the dentation of the legs, notably the teeth on the upper edge, quite identical with those of the perfect form in all my specimens. The size is also less—from 3¾ to 4¼ in.., and the body more slender.

The eggs are elliptic, cylindrical, about one-eighth inch long and half as thick, wrinkled, greyish black when mature, and open with a lid at one end, which bears a conspicuous round knob.

They live upon stringybark shrubs in the Mount Lofty Ranges.

Digitized by Google

Additions to the Flora of Kangaroo Island.

By J. G. O. Tepper, F.L.S., &c.

[Read September 7, 1886.]

Being attached to an exploring party under the leadership of Mr. J. E. Brown, the Conservator of Forests, and Mr. A. Molineux, for the purpose of collecting for the Museum, I availed myself of the opportunity of making some observations on the flora of the island.

Starting from Queenscliffe on the 25th of February last, the track along the telegraph line to Cape Borda was generally followed, passing in succession Kinch's Station on the South Western River, Digger's Camp, Rocky and Grassy Creeks, the Head of the South Western River, Ravine des Casoars, Harvey's Return, and reached Cape Borda on the 1st of March. A day was spent at Harvey's Return, after which the Head of the South Western River was again visited, but from thence a detour made to Karatta Station, near the mouth of the Stunsailboom River on the south coast of the island, from thence returning by the Eleanor River, Mount Pleasant Station, Birchmore's Lagoon to the South Western River, a mile or two west of the bridge, on the 7th of March. On the route some 200 species of plants were gathered, but many as yet undetermined, notably most of the Rhamneæ, many being imperfect on account of the lateness of the season.

The following species and varieties are new for the flora of the island; those marked with an asterisk also new for the province:—

RANUNCULACEÆ.

Ranunculus rivularis, *Banks & Sol.* Ravine des Casoars.

RUTACEÆ.

Boronia Edwardsii, *Benth.* Head of South Western River.

Correa æmula, *F. v. M.* Head of the South Western. Hitherto very rare, peculiar to South Australia.

SAPINDACEÆ.

Dodonæa bursarifolia, *Beer.* Ravine des Casoars.

LEGUMINOSÆ.

Pultenæa daphnoides, *Sonder.* Head of South Western.

*Pultenæa scabra, *R. Br.* Head of South Western.

Acacia myrtifolia, *Willd.*, variety angustifolia, *F. v. M.* Very common in the form of low dense shrubs of three to five feet, between Grassy Creek and the Ravine des Casoars.

Digitized by Google

*Acacia Whanii, *F. v. M.* A few shrubs seen on the banks of a dry creek south-west of Birchmore's Lagoon.

SAXIFRAGEÆ.

Bauera rubioides, *Andr.* Grassy and other creeks, and at the head of the South Western.

HALORAGEÆ.

Loudonio aurea, *Lindley.* Banks of a lagoon south of the head of the South Western.

MYRTACEÆ.

Eucalyptus Sieberiana, *F. v. M.* Harvey's Return.

RHAMNACEÆ.

Cryptandra hispidula, *Reiss.* Digger's Camp.

OLACINEÆ.

Olax Benthamiana, *Miquel.* Scrubland near Cape Borda. An additional family to this flora.

PROTEACEÆ.

Grevillea pauciflora, *R. Br.* Head of the South Western.
Hakea ulicina, *R. Br.*; var. carinata, *F. v. M.* Cape Borda.

GENTIANEÆ.

Limnanthemum sp. Ravine des Casoars.

ASPERIFOLIÆ.

Halgania lavandulacea, *Endl.* Head of the South Western.

EPACRIDEÆ.

Styphelia hirtella, *F. v. M.* Scrublands, Mount Pleasant.
Styphelia serrulata, *Lab.* (var.) Head of South Western, &c.

FLUVIALES.

Lepilæna Preissii, *F. v. M.* Karatta.

RESTIACEÆ.

Leptocarpus tenax, *R. Br.* Birchmore's Lagoon.

JUNCEÆ.

Juncus cæspitius, *E. Meyer.* Ravine des Casoars.

CYPERACEÆ.

*Schœnus fluitans, *J. Hooker.* Head of South Western.
Schœnus capillaris, *F. v. M.* Head of South Western.
Cladium tetraquetrum, *Hooker.* Head of South Western.
Lepidosperma carphoides, *F. v. M.* Mount Pleasant.

FILICES.

Schizæa fistulosa, *Labill.* Head of South Western.

Digitized by Google

TROCHIDÆ AND OTHER GENERA OF SOUTH AUSTRALIA, WITH THEIR SYNONYMS.

PART I.

By JOHN BRAZIER, F.L.S., C.M.Z.S., &c.

[Read October 5, 1886.]

1. TROCHUS (CANTHARIDUS) LESUEURI, *Fischer*, sp.

1822. *Phasianella elegans*, Lam., Anim. sans Vert., vol. 7, p. 53, No. 4.

1843. *Phasianella elegans*, Lam., 2nd edit. (Deshayes), vol. 9, p. 243.

**Trochus elegans*, Kiener Genus Trochus, Coq. Vivantes, pl. 4, 5, fig. 2 (non *Trochus elegans*, Gmelin).

1843. *Trochus Lehmanni*, Menke, Moll. Novæ Hollandiæ, p. 18, No. 70 (non *Trochus Lehmanni*, Kiener).

1845. *Trochus Lehmanni*, Menke; Philippi in Abbild Besch neuer Conch., vol. 2, heft 2, p. 37, pl. 7. *Trochus*, fig. 2 (non *Trochus Lehmanni*, Kiener).

1845. *Trochus Lehmanni*, Menke; Catlow and Reeve, Conchologists' Nomenclator, p. 217, No. 75.

†1849. *Trochus pictus*, Philippi in Conch. Cab., 2nd edition, p. 139, No. 166, pl. 23, figs. 18-19 (non *Trochus pictus*, Wood).

1851. *Thalotia Lehmanni*, A. Adams, Proc. Zool. Soc., p. 172, No. 4.

1873. *Thalotia Lehmanni*, Paetel, Catalog. der Conch.-Sammlung, p. 73.

1877. *Thalotia picta*, Tenison-Woods, Papers and Proc. Royal Soc., Tasmania, p. 41.

1880. *Trochus Lesueuri*, Fischer; in Kiener Coq. Vivantes, p. 129-420.

Hab.—Coast of Australia (*Peron and Lesueur*); St. Vincent's Gulf, South Australia (*G. F. Angas*, *W. Bednall*, *Professor Tate*); Swan River (*Preiss*); Cape Riche, King George's Sound

---

* The date of publication of Kiener "Spécies général et Iconographie des Coquilles Vivantes" is not given. The date is given in that edited by Dr. Fischer.

† The title-page of the genus Trochus in the Conchylien Cabinet is missing in the copy in the Australian Museum. I have only been able to find that the work must have been published about the year 1849-50.

Digitized by Google

(*Brazier*); Fowler's Bay and Encounter Bay (*Tate*); North Tasmania (*Tenison-Woods*),

This species was described first by Lamarck as *Phasianella elegans*, and placed by Kiener in the genus Trochus in his Coquilles Vivantes. It is not the *Trochus elegans* of Gmelin, which is the *Trochus purpuratus* of Martyn. *T. elegans* is the *T. Lehmanni*, Menke, and the *Trochus pictus*, Philippi, not of Wood. Dr. Fischer points out in Kiener, page 129, that the figure of *Trochus pictus*, Wood, is very doubtful, and a new specific name being required for Kiener's, he renames it *Trochus Lesueuri*, Fischer. This is the same species that is quoted by the Rev. Tenison-Woods and Mr. Angas as the *Trochus pictus*, Wood.

2. TROCHUS (THALOTIA) CONICUS, *Gray*, sp.,

1827. *Monodonta conica*, Gray in Captain King's Survey of Australia, Appendix; vol. 2, p. 479, No. 28.

1828. *Trochus pictus*, Wood, Index Testaceologicus, Suppliment, p. 17, pl. 5, Trochus fig. 28.

* *Trochus Lehmanni*, Kiener, Coq. Vivantes Genus Trochus, pl. 46, fig. 2-2a, (non *Trochus Lehmanni*, Menke).

1843. *Monodonta turrita*, Menke, Moll. Novæ Hollandiæ, p. 15, No. 57.

†1849. *Trochus conicus*, Gray; Philippi in Conchylien Cabinet, 2nd edition, p. 130, No. 150, pl. 23, fig. 1.

1849. *Trochus turritus* (Monodonta), Menke=*conicus*, Gray, Philippi in Conch. Cabinet, p. 372, index.

1851. *Thalotia picta*, A. Adams, Proc. Zool. Soc., London, p. 172, No. 1.

1854. *Thalotia conica*, Gray; H. and A. Adams, Genera of Recent Mollusca, vol. 1, p. 420, pl. 48, fig. 1.

1854. *Trochus Lehmanni*, Hombron and Jacquinot Voyage au Pôle-Sud (Zoologie), vol. 5, p. 54; Atlas plates, Mollusca, pl. 14, fig. 7-8 (non *Trochus Lehmanni*, Menke.

1854. *Thalotia picta*, H. and A. Adams, Genera of Recent Mollusca, vol. i., p. 420.

1856. *Trochus pictus*, Wood, Index Test Suppliment (Hanley's edition), p. 220, pl. v., Trochus, fig. 28.

1859. *Trochus* (*Thalotia*) *Lehmanni*, Chenu, Manual de Conch., t. 1, p. 359, fig. 2,659 (non *Trochus Lehmanni*, Menke).

1865. *Thalotia picta*, Angas (as of Wood), Molluscan Fauna of South Australia, Proc. Zool. Soc., London, p. 179, No. 148.

1873. *Thalotia conica* (Sowerby!!), Paetel, Catalog der Conch.-Sammlung, p. 73.

1877. *Thalotia picta*, Tenison-Woods (as of Wood), Papers and Proc. Royal Soc., Tasmania, p. 41.

1880. *Trochus conicus*, Fischer, in Kiener Coq. Vivant, p. 135.

Digitized by Google

1881. *Monodonta turrita*, Menke=*Thalotia conica*, Gray; Tate, Proc. Linn. Soc., N.S.W., vol. 6, p. 394.

Hab.—King's Island, Bass Straits (*Peron* and *Lesueur*); New Holland (*Captain King*); St. Vincent Gulf, South Australia (*G. F. Angas*, *W. T. Bednall*); Bass Straits and North-East Tasmania (*Tenison-Woods*, *W. F. Pettard*); Kangaroo Island (*Tate*).

There has been great confusion in reference to this species. It was first of all described by Dr. J. E. Gray as *Monodonta conica* in 1827. In 1828 it is figured and called *Trochus pictus* by Gray or Wood in the Index Testaceologicus. If any naturalist will only examine the figure well in the Index Test: he will at once see the figure shows three small denticulations on the columellar. A number of specimens of the slender form I have from St. Vincent Gulf are true to Wood's fig. in Index Test. Philippi, in the Conchylien Cabinet, makes *Trochus Lehmanni*, Menke, a synonym of *Trochus pictus*, Wood. The *Trochus Lehmanni*, Menke, is the *Trochus Lesueuri*, Fischer, described by Lamarck as *Phasianella elegans*. Kiener also calls it *Trochus Lehmanni*. A. Adams in 1851 comes much nearer than any previous authors, for he quotes it as *Thalotia picta*, Wood, Proc. Zool. Soc., London, and makes *Monodonta turrita*, Menke, its synonym. Philippi, in the Index to the Conchylien Cabinet, quotes Menke's *turritus* as the synonym of *Trochus conicus*, Gray. In 1854 Hombron and Jacquinot give splendid figures of it in the Voyage au Pôle-Sud as *Trochus Lehmanni*. Chenu also figures it as *Trochus Lehmanni*, but it is not the *Trochus Lehmanni* of Menke. Mr. Angas quotes this as *Thalotia picta*, and Tenison Woods does the same. The species they refer to is *Trochus Lesueuri*, Fischer; the *Phasianella elegans*, Lamarck. Paetel erroneously attributes *Trochus conicus* to Sowerby.

3. Trochus (Cantharidus) pulcherrimus, *Gray*, sp.

1828. *Trochus pulcherrimus*, Gray; Wood, Index Test. Suppliment, p. 18, pl. 6, fig. 45; *Monodonta pulcherrima*, Gray, l.c., p. 44.

1842. *Trochus Preissii*, Menke, Moll. Nov. Hollandiæ, p. 17, No. 69.

1845. *Trochus pulcherrimus*, Wood; Philippi Abbild neuer Conch., vol. 2, heft 2; Trochus, p. 37, pl. 7, fig. 1.

†*1849. *Trochus pulcherrimus*, Wood; Philippi in Martini and Chemn, 2nd edition (Kuster), p. 132, No. 153, pl. 23, fig. 4.

1850. *Trochus pulcherrimus*, Wood; Jay's Catalogue of Shells, 4th edition, p. 306, No. 7,440.

Digitized by Google

1851. *Thalotia pulcherrima*, Wood; A. Adams, Proc. Zool. Soc., p. 172, No. 2.
1854. *Thalotia pulcherrima*, Wood; H. and A. Adams, Genera of Recent Mollusca, vol. 1, p. 420.
1856. *Trochus pulcherrimus*, Gray; Wood, Index Test. Suppl., Hanley's edition, p. 221, pl. 6, fig. 45; very bad.
1865. *Thalotia pulcherrima*, Wood; Angas, Molluscan Fauna of South Australia, Proc. Zool. Soc., p. 179, No. 151.
1873. *Thalotia pulcherrima*, Wood; Paetel, Catalog. der Conch.-Sammlung, pp. 11-73.
1877. *Thalotia mariæ*, Tenison-Woods, Proc. Royal Soc., Victoria, p. 58.
1877. *Thalotia mariæ*, Tenison-Woods, Papers and Proc. Royal Soc., Tasmania, p. 41.
1881. *Trochus Preissii*, Menke=*Thalotia pulcherrima*, Wood; Tate, P. L. S., N.S.W., vi., p. 396.

Hab.—Swan River, Western Australia (*Preiss*); Cape Riche, King George's Sound, south-west coast of Australia (*J. Brazier*); Hobson's Bay and Port Phillip Heads (*Tenison-Woods*); Rossiter Bay, Recherche Archipelago, Great Australian Bight (*Captain Thomas Rossiter*, 1841); Encounter and Fowler's Bay (*Tate*); Holdfast and Aldinga Bays, South Australia (*G. F. Angas*); North Tasmania (*Tenison-Woods*, *W. F. Pettard*, *Lieut. Beddome*).

This well-known species was re-described by the Rev. Tenison-Woods in 1877 as *Thalotia mariæ*—the type specimen he presented to the Australian Museum.

4. Trochus (Diloma) odontis, *Gray*, sp.

1828. *Trochus odontis*, Gray; Wood, Index Test. Suppliment, pl. 6, fig. 37; *Monodonta odontis*, Gray, l.c., p. 44.
†*1849. *Trochus odontis*, Wood; Philippi, in Conch. Cab., Martini and Chem., 2nd edition, p. 144, pl. 24, fig. 7.
1851. *Chlorostoma odontis*, A. Ad., Proc. Zool. Soc., p. 182, No. 22.
1854. *Diloma odontis*, Wood; H. and A. Adams, Recent Mollusca, vol. 1, p. 420.
1856. *Trochus odontis*, Gray; Wood's Index Test. Suppliment, Hanley's edition, p. 221, pl. 6, fig. 37.
1865. *Diloma odontis*, Wood; Angas, Molluscan Fauna of South Australia, Proc. Zool. Soc., p. 182, No. 173.
1873. *Gibbula odontis*, Wood; Paetel, Cat. der Conch.-Sammlung, p. 75.
1877. *Trochus* (*Diloma*) *odontis*, Wood; Tenison-Woods, Proc. and Papers, Royal Soc., Tasmania, p. 43.
1880. *Trochus odontis*, Wood; Kiener, Coq. Vivantes Fischer ed. Trochus, pp. 313-423, No. 180, pl. 99, fig. 1.

Digitized by Google

Hab.—New Holland (*Philippi*); Port Phillip, on the rocks at low water (*Jukes*); St. Vincent's Gulf, South Australia, and Tasmania (*G. F. Angas*); New Holland (*Paetel*); Port Western (*Quoy* and *Gaimard*); Hobson's Bay, Victoria (*R. C. Rossiter*); Port Sorell, Tasmania (*C. E. Beddome*); Wallaroo, South Australia (*G. T. Rossiter*, 1861); St. Vincent's Gulf, South Australia, on rocks at low water (*Prof. Tate*); St. Kilda Beach, Hobson's Bay, Victoria (*J. H. Gatliff*); Hobson's Bay, Victoria (*G. T. Rossiter*, 1862); Brighton, Victoria (*J. F. Bailey*); Blackman's Bay, Tasman's Peninsula, Port Davey, Swansea, and Tamar Heads, Tasmania (*W. F. Pettard*); Cape of Good Hope (*Hanley*, in Wood's Index Test., 2nd edition).

5. Trochus (Diloma) Adelaidæ, *Philippi*, sp.

†*1849. *Trochus Adelaidæ*, Philippi in Martini and Chem., 2nd edition, Kusters, p. 140, No. 168, pl. 24, fig. 1.

1851. *Gibbula Adelaidæ*, A. Adams, Proc. Zool. Soc., p. 186, No. 22.

1854. *Oxystele Adelaidæ*, H. and A. Adams, Genera of Recent Mollusca, vol. 1, p. 427.

1873. *Oxystele Adelaidæ*, Phil.; Paetel, Cat. der Conch.-Sammlung, p. 74.

1876. *Diloma Australis*. Tenison-Woods. Papers and Proc. Royal Society of Tasmania, p. 145.

1877. *Trochus* (*Diloma*) *australis*, Tenison-Woods, Papers and Proc. Royal Society of Tasmania.

1880. *Trochus Adelaidæ*, Phil.; Kiener, Coq. Vive, Fischer ed. Trochus, p. 210.

1884. *Diloma australis*, Tenison-Woods; Hutton, Proc. Linn. Society of N.S.W., vol. 9, p, 368.

Hab.—Rossiter Bay, Recherche Archipelago, Great Australian Bight (*Captain Thomas Rossiter*, 1841); Rocks at low tide, Great Australian Bight (*Professor Tate*); St. Vincent's Gulf, South Australia (*W. T. Bednall*); Adelaide in New Holland (*Philippi*); North coast of Tasmania (*W. F. Pettard*); Cape Riche, King George's Sound (*Brazier*); Portland, Victoria (*J. H. Gatliff*).

I have the original specimens of this species, and many others collected by my father-in-law, Captain Thomas Rossiter, in 1841. The year that he saved Mr. John Eyre (now Sir John Eyre) from starvation when on his ever-memorable trip overland from Adelaide to King George's Sound. Specimens I distributed some years ago as *Trochus Adelaidæ*, Philippi, they being identified by the late Messrs. Henry and Arthur Adams, but for some unknown reason the Rev. Tenison-Woods re-describes it as *Trochus australis*. I have seen it in collections named *Trochus odontis*, Gray, var. specimens from St. Vincent's Gulf sent by Mr.

Digitized by Google

Bednall some years back as *Trochus odontis?* Wood. I think that Mr. Angas must have mixed up two species in one. He only mentions *Trochus odontis* in his list of the South Australian Mollusca.

6. Trochus (Zizyphinus) Meyeri, *Philippi*, sp.

1848. *Trochus Meyeri*, Philippi, Zeitscher fur Malak, p. 101.
†*1849. *Trochus Meyeri*, Philippi, in Conch. Cab., 2nd edition, p. 279, No. 362, pl. 41, fig. 4.
* *Trochus armillatus*, Kiener, Coq. Viv. Genus Trochus, p. 17, fig. 2 (non *Trochus armillatus*, Wood, Index Test).
1854. *Trochus levis*, Hombron et Jacquinot Voyage au Pôle Sud, vol. 5, Zoologie, p. 56, atlas plates, Mollusca, pl. 14, fig. 17-18.
1863. *Zizyphinus armillatus*, Reeve, Conch. Icon., p. 3, fig. 19 (non *Trochus armillatus*, Wood).
1865. *Zizyphinus armillatus*, Angas, Molluscan Fauna of South Australia, Proc. Zool. Soc., p. 180 (non *Trochus armillatus*, Wood).
1873. *Zizyphinus armillatus*, Paetel, Catalog. der Conch.-Sammlung, p. 73 (non *Trochus armillatus*, Wood).
1873. *Zizyphinus Meyeri* (Dunker!!), Paetel, Catalog. der Conch.-Sammlung, p. 74.
1877. *Zizyphinus armillatus*, Tenison-Woods, Papers and Pro. Royal Society of Tasmania, p. 41 (non *Trochus armillatus*, Wood).
1880. *Trochus Meyeri*, Philippi; Fischer, in Kiener Coq. Vivantes Genus Trochus, p. 76, No. 10.

Hab.—King's Island, Bass Straits (*Peron* and *Lesueur*, Naturalists to Captain Baudin's Expedition); Encounter and Guichen Bays, South Australia (*G. F. Angas*); New Holland (*Hombron* and *Jacquinot*); Tasmania (*Paetel*, *Beddome*, *Woods*, *Pettard*); Australian Sea (*Paetel*); Western Port, inside the West Head (*J. H. Gatliff*); Coast of Australia (*J. Verreaux*).

It is quite a mystery how this species has got confused with the *Trochus armillatus* Wood figured in the Suppliment to the Index Testaceologicus, in 1828, The *Trochus Meyeri*, Philippi, is quite distinct both as regards colour and sculpture; the figure given by Reeve as *T. armillatus* is very bad. The figures given by Philippi, Kiener, and Hombron and Jacquinot of this well-known species are not to be surpassed. Paetel erroneously attributes this species to Dr. Dunker.

7. Trochus (Clanculus) Dunkeri, *Koch*, sp.

1843. *Trochus* (*Monodonta*) *Dunkeri*, Koch in Philippi, Abbild und Besch neuer oder Conch., vol. 1; Trochus, heft. III., p. 67, pl. 2, fig. 5.

Digitized by Google

†1849. *Trochus Dunkeri*, Koch; Philippi in Conch. Cab., 2nd edition, p. 237, No. 300, pl. 36, fig. 5.
1851. *Monodonta Dunkeri*, Koch; A. Adams, Proc. Zool. Soc., p. 174.
1854. *Euchelus Dunkeri*, H. and A. Adams, Genera of Recent Mollusca, vol. 1, p. 419.
1865. *Clanculus rubens*, A. Adams; Angas, Molluscan Fauna of the Province of South Australia, Proc. Zool. Soc., p. 178.
1877. *Clanculus rubens*, A. Adams; Tenison-Woods, Papers and Proc. Royal Society of Tasmania, p. 40.
1880. *Trochus* (*Clanculus*) *Dunkeri*, Koch; Kiener, Coq. Vivantes Fischer ed., p. 301 and 422, No. 171, pl. 96, fig. 2.

Hab.—? (*Koch*); Adelaide in New Holland (*Philippi*); St. Vincent's Gulf (*G. F. Angas, Tate*); Bass' Straits (*Tenison Woods*); Streaky Bay (*Tate*).

8. Diala lauta, *A. Adams*, sp.

1862. *Diala lauta*, A. Adams, Ann. Nat. Hist., vol. 10, 3rd series, p. 298, No. 5.
1865. *Diala lauta*, A. Adams; Angas, Proc. Zool. Society, p. 173, No. 111.
1873. *Diala lauta*, A. Adams; Paetel, Catalog der Conch.-Sammlung, pp. 6-49.
1875. *Diala Punctata*, Tenison-Woods, Paper and Proc. Royal Soc., Tasmania, p. 147.
1875. *Diala lauta*, A. Adams; E. A. Smith, Proc. Zool. Soc., p. 538.
1877. *Diala punctata*, Tenison-Woods, Papers and Proc. Royal Soc., Tasmania, p. 37.

Hab.—Port Adelaide (*A. Adams*); St. Vincent's Gulf, in shell sand at the head of Spencer's Gulf, South Australia (*G. F. Angas*); D'Entrecasteaux Channel, South Tasmania (*Rev. H. D. Atkinson*); very abundant on the Zostera fields in sheltered stations throughout South Australia (*Tate*).

9. Diala monile, *A. Adams*, sp.

1862. *Alaba monile*, A. Adams, Ann. Nat. History, vol. 10, 3rd series, p. 296, No. 17.
1865. *Alaba monile*, A. Adams; Angas, Proc. Zool. Soc., p. 173, No. 109.
1875. *Diala tesselata*, Tenison-Woods, Papers and Proc. Royal Society, Tasmania, p. 147.
1875. *Diala monile*, A. Ad., E. A. Smith, Proc. Zool. Soc., p. 538.
1877. *Diala tesselata*, Tenison-Woods, Papers and Proc. Roy. Soc., Tasmania, p. 37.

Digitized by Google

Hab.—Port Lincoln (*W. Metcalfe, A. Adams*); Port Lincoln, South Australia, in shell sand (*G. F. Angas*); Crookhaven Head, New South Wales, in shell sand found on the beach (*J. Brazier*).

10. CASSIS SEMIGRANOSA, *Lam.*, sp.

1822. *Cassis semigranosa*, Lam., Hist. Anim. sans Vert., tome 7, p. 228, No. 23.
1824. *Cassis semigranosa*, Lam., Dubois' Epitome of Lamarck's Arrangement of Testacea, p. 253.
1828. *Buccinum semigranosum*, Wood, Index Test. Suppliment, p. 11., pl. iv., fig. 2.
* *Cassis semigranosa*, Lam.; Kiener ed. Fischer, Icon. Coq. Viv., p. 36, No. 23, pl. 14, fig. 29.
1844. *Cassis semigranosa*, Lam., Anim. sans. Vert. (Deshayes ed.), vol. 10, p. 37.
1845. *Cassis semigranosa*, Lam.; Catlow and Reeve, Conchologists' Nomenclator, p. 263, No. 37.
1848. *Cassis semigranosa*, Lam.; Reeve, Conch. Icon., vol. v., p. 1, species 3.
1850. *Cassis semigranosum*, Lam.; Jay, Catalogue of Shells, 4th edition, p. 345, No. 8,736.
1853. *Semicassis semigranosa*, Lam.; H. and A. Adams, Genera of Recent Mollusca, vol. 1, p. 216.
1856. *Buccinum* (*Cassis*) *semigranosa*, Lam.; Hanley, in Index Test. Suppliment, 2nd edition, p. 212, pl. 4, fig. 2.
1857. *Cassis semigranosum*, Wood; Küster, in Martini and Chem., 2nd ed., p. 24, pl. 44, fig. 6, 7.
1859. *Cassis* (*Semicassis*) *semigranosus*, Lam.; Chenu, Manual de Conch., tome 1, p. 206, fig. 1,124.
1860. *Cassis semigranosa*, Lam.; W. Theobald, Catologue of the Recent Shells in the Museum Asiatic Society of Bengal, p. 18, No. 10.
1865. *Semicassis semigranosa*, Lam.; Angas, Molluscan Fauna of South Australia, Proc. Zool. Soc., London, p. 168.
1873. *Cassis* (*Phalium*) *semigranosa*, Lam.; Paetel, Cat. der Conch.-Sammlung, p. 5-44.
1876. *Cassis semigranosa*, Lam.; Tenison-Woods, Proc. and Papers of the Royal Society of Tasmania, p. 33.
1885. *Cassis* (*Semicassis*) *semigranosa*, Wood; Tryon, in Manual of Conchology, vol. 8, p. 275, pl. 3, fig. 60.

Hab.—Seas of New Holland (*Lamarck*); Van Diemen's Land (*Reeve*); Seas of New Holland (*Kiener*); Coast of New Holland (*Küster*); Van Diemen's Land (*Hanley*); Aldinga Bay, Encounter Bay, South Australia (*G. F. Angas*); Wallaroo Bay (*Tate*); Tasmania (*Beddome, Petterd, Simson, Woods*).

This well-known species was first described by Lamarck in 1822, mentioned again in 1824 by Dubois, in his Epitome of

Digitized by Google

Lamarck's Arrangement of the Testacea, in 1824. Wood, in his Index Test. Suppliment, 1828, figures it as *Buccinum semigranosum* from specimens in the British Museum. Kiener, in his Coquilles Vivantes, figures it as *Cassis semigranosa*, Lam. Deshayes, Catlow and Reeve, Jay, H. and A. Adams, Hanley, Chenu, Theobald, Angas, Paetel, Tenison-Woods, all quote Lamarck; and after 62 years we are told that Wood is the authority for the species by Mr. Tryon, in his Manual of Conchology, vol. 8, p. 275, 1885, and quotes Reeve, Conch. Icon., for it. Reeve does not quote Wood, but Lamarck, Anim. sans Vert. (Deshayes' edit.), vol. X., p. 37. Küster, in Conchilien-Cabinet, Martini and Chemnitz, 2nd edition, 1857, quotes Wood, and ignores Lamarck. Of all the authorities I have quoted from 1822 until 1885, Küster and Tryon are the only two who have given Wood as the authority—probably an oversight; but it causes endless confusion to young students who have not a large library to consult. I am very often asked who is the authority for the species, Lamarck or Wood. My list drawn up in this paper will show all students the authority for the species.

11. CERITHIUM (POTAMIDES) MONACHUS, *Crosse* and *Fischer, sp.*

1855. *Cerithium dubium*, Sowerby, Thes. Conch, vol. 2, p. 864, No. 2, pl. 181, fig. 120 (non *Cerithium dubium*, Sowerby, Mineral Conch., 1816).

1864. *Cerithium monachus*, Crosse and Fischer, Journal de Conch., p. 347, pl. 3, fig. 17-18.

1865. *Potamides monachus*, Angas, Molluscan Fauna of South Australia, Pro. Zool. Soc., p. 171, No. 97.

1865. *Cerithium dubium*, Sowerby; Reeve, Conch. Icon., pl. 12, species 78 *a–b* (non Sowerby, 1816).

1877. *Cerithium dubium*, (Reeve!!); Tenison-Woods, Papers and Proc. Royal Society, Tasmania, p. 35 (non *dubium*, Sowerby, 1816).

1880. *Cerithium eludens*, Bayle, Journal de Conch., vol. 27, 3rd series, p. 245, No. 9.

Hab.—Van Diemen's Land (*Sowerby*); Yorke's Peninsula, Adelaide Creek, South Australia (*G. F. Angas*); on the beach at St. Kilda, Melbourne (*G. F. Angas*); occasionally taken alive in shallow water in St. Vincent Gulf, and beach specimens have been gathered at several stations in Spencer Gulf (*Tate*).

Sowerby described in his Mineral Conchology, in 1816, a *Cerithium dubium*. Bayle, in the French Journal, 1880, renames it as *Cerithium eludens*, not knowing that Crosse and Fischer had described it as *Cerithium monachus* in the same Journal for 1864. Crosse and Fischer's name must stand good.

Digitized by Google

12. TURBO GRUNERI, *Philippi.*

1846. *Turbo Gruneri*, Philippi in Zeitschrift fur. Malak, p. 98; Philippi in Martini and Chemnitz Conch. Cab., 2nd edition, p. 52, pl. 12, fig. 7.
1848. *Turbo circularis*, Reeve, Conch. Icon, pl. 10, sp. 46.
1854. *Senectus circularis*, Reeve; H. and A. Adams, Recent Mollusca, vol. 1, p. 392.
1865. *Senectus circularis*, Reeve; Angas, Marine Molluscan Fauna of the Province of South Australia, Proc. Zool. Soc., p. 177.
1873. *Turbo circularis*, Reeve; Fischer in Kiener Coq. Vivantes, p. 99, pl. 42, fig. 1.
1873. *Turbo* (*Senectus*) *circularis*, Reeve; Paetel Catalog der Conch.-Sammlung, p. 71.
1877 *Turbo* (*senectus*) *circularis*, Reeve; Tenison-Woods, Papers and Proc. Royal Soc., Tasmania, p. 38.
1885. *Turbo curcularis*, Reeve; Sowerby, Thes. Conch., p. 203, sp. 42, pl. 4; Thes., plate 496, fig. 37.

Hab.—Adelaide, South Australia (*Philippi*); "——?" (*Reeve*); St. Vincent's Gulf, South Australia (*G. F. Angas*); Holdfast Bay (*W. T. Bednall, Tate*); King's Island, Bass Straits (*Tenison-Woods*); Swan River, Australia (*Sowerby*).

I hope soon to give Part II. with a number of species that have not been recorded by Mr. G. F. Angas since they were described in 1843. Specimens that I have were collected at Port Lincoln. I have to thank Professor Tate, Messrs. Bednall, Beddome, Pettard, Gatliff, and other friends for numerous species with correct localities.

Digitized by Google

A Classified List of Geometrina found round Balhannah, with Notes on Species.

By E. Guest, Balhannah.

[Read October 5, 1886.]

The Geometrina of South Australia, so far as I know, are included in five sub-families—the *Larentidæ*, *Ænochromidæ*, *Geometridæ*, *Acidalidæ*, and *Boarmidæ*.

The genera, with the exception of perhaps half a dozen, appear to be distinct from those of Europe, and I do not think that a single species mentioned below is common to these two parts of the world. The larvæ feed on trees and shrubs, as a rule, although I have little doubt that some of those of the *Acidaliadæ* are found on grass or low herbs. They are generally solitary, devoid of hair, and have the prolegs or claspers on the posterior segments only, which causes the larva to loop or draw up its body in walking. Many of the Australian species attach themselves by the anal pair to some twig or leaf, and stretch the body straight out, in which position they look exactly like a small dead branch. The perfect insects may be found flying over grass, beaten from trees or shrubs, or sitting with expanded wings on fences or walls. They mostly fly in the evening, but some few appear to be day-flying as well. I have no intention of minutely describing the species, as this has already been done by abler pens than mine, but shall draw attention to such prominent markings as may enable the student to recognise such examples as may be included in this list.

The mean will be generally given in inches and lines (thus ′ and ″), but where the sexes vary very much in size, that of both will be mentioned if known.

Sub-family I.—Larentidæ.

Is represented in my collection by nineteen species and seven genera. They are small or medium-sized insects, frequenting grassy places, and may often be found on fences; but I do not think that they are as a rule much attracted by light.

1. Microdes villosata, *Gn.*

Expanse, 10″. Out in November.

Fore-wings dark ash-gray, mottled with darker. Hind-wings yellowish white, with a round nearly black spot at lower edge,

Digitized by Google

near anal angle. This looks as if it had been burned through the wing, and distinguishes the species immediately. Generally considered common, but I have only once captured it in this locality.

2. PHRIXOGONUS LATICOSTATUS, *Walk.*

Expanse, 7″. October, November, December, and again in March.

General colour purplish-brown, with a much darker irregular bar across the wing. The male may be known at once by a long tuft of scales projecting from costa at one-fourth from base. This is absent in the female, which has also the dark bar much narrower and quite straight. A common insect; sits on tree trunks and fences.

3. PHRIXOGONUS INSIGILLATUS, *Walk.*

Expanse, 6″ to 7″. March.

Fore-wings more pointed and costa more arched than in *laticostatus*, and it is also lighter coloured. The costal tuft is wanting, but there is a raised knob of scales below costa at one-half. Not common.

4. EPICYME RUBROPUNCTARIA, *Dbld.*

Expanse, 10″. November and December, and again in March.

A pretty light pink-coloured insect, with fine transverse lines of a darker shade. There are generally three or four large confluent purplish-red spots running from centre of wing to inner margin, but these are often nearly obsolete, and in one of my specimens they form a band running right across the wing. Common.

5. ANACHLORIS SUBOCHRARIA, *Dbld.*

Expanse, 1′. October to May.

Bright orange yellow, with a tawny stripe across wing at two-thirds. Hind margin tawny, and the space between this and central stripe is often suffused with a lighter shade of the same colour. Very common.

6. CEPHALISSA SEVERATA, *Gn.*

Expanse, 1′ October and November.

Dark grey, with nearly black basal patch, and a broad black stripe across centre of wing. The female is more obscurely marked than the male, and might almost be taken for another species. Sits on prostrate logs, and flies very fast when disturbed. A common species.

7. CEPHALISSA MORTUATA, *Gn.*

Expanse, 11″. March and April.

Digitized by Google

A very variable insect, if indeed all my varieties really belong to this species, as is Mr. Meyrick's opinion at present. They may mostly, however, be known by a transverse bar, broad on costa, narrow on inner margin, very angulated on outside and margined by *a white line, which expands into a kind of spot near the costa.* The ground colour is dark greyish-brown, and the females are darker than the males. Common.

8. CEPHALISSA CHIMARRHOA, *Meyr.*

Expanse, 10″.

All the wings a bright lustrous yellowish-brown, difficult to describe. Across the wing, rather beyond one-half, is a series of seven or eight small triangular spots, with the apices turned inwards and black, the bases being white. This little insect was unknown until I took it, and I believe it has as yet only occurred here.

9. CEPHALISSA MICROCYMA, *Meyr.*

Expanse, 11″.

At first sight this looks something like *chimarrhoa*, but the ground colour is lighter, the triangular spots are wanting, and the antennæ of male are plumated, whilst in that insect they are almost simple. Fairly common some years, flying among grass, but appears to be confined to South Australia, and was unknown until I took it.

10. CEPHALISSA HOLOPHANES, *Meyr.*

Expanse, 1′ 1″. October and November.

Fore-wings yellowish grey, with a very faint and indistinct darker bar, *which is nearly straight-edged*, across the centre. In some specimens, however, this is almost obsolete. Hind wings bright yellow, with darker hind margins. Only found in South Australia, and is in few cabinets as yet. It is pretty common around Balhannah, and was first taken by myself.

11. CEPHALISSA LAMPROTIS, *Meyr.*

Expanse, 10″. March.

Fore-wings purplish-grey, with a broad dark purplish-brown bar across centre, very sharply angulated outwards; beyond this, on the costa, are two patches of the same colour, the first larger than the second. The hind wings are deep orange, suffused with brown. This small but handsome insect appears to be really scarce everywhere, although widely distributed. Found among grass on hillsides.

12. CEPHALISSA LANGUESCENS, *Rosenstock.*

Expanse, 1′ 1″. Fore-wings dark-brown, with a still darker bar across the centre. Hind-wings dark orange, suffused with

Digitized by Google

brown towards anal angle. Not a common insect, and, I believe, restricted to this colony. Flies in March.

13. CEPHALISSA VACUARIA, *Gn.*

Expanse, 1′ 1″. March and April.

A variable insect as to ground colour, which is sometimes dark-brown, sometimes tawny. There is always, however, a nearly black bar, broad at costa and pinched in the centre, running across the wing, and very much angulated on the outside. The hind-wings are grey. A common insect, flying over grass.

14. CEPHALISSA STRUMOSATA, *Gn.*

Expanse, 1′ 5″. December and January.

This is the largest and darkest of the genus yet found by me. The ground colour, however, varies a good deal, being sometimes very dark grey, and sometimes, especially in the females, positively black, in which case the head, thorax, and body are all of the same sombre hue. There is always a darker broad bar crossing the wing, very much angulated on the outside, and distinguished from any other species known to me by having two protuberances close together. Sits on palings and trees—the dark ones on charred trunks, where, in spite of their size, they are almost invisible. Rather a common species.

15. CEPHALISSA SUBRECTARIA, *Gn.*

Expanse, 10″ to 1′ 1″. September and October.

A dull-coloured insect frequenting damp places near creeks, rivers, &c. It may be known at once by a straight, narrow, silvery-white bar crossing the fore wings at three-fourths, and another broader, but less distinct rounded one, at one-fourth from base. Generally common.

16. CEPHALISSA UNCINATA, *Gn.*

Expanse, 10″ to 1′ 1″. October and November.

A very variable insect, both in markings and ground colour, but nevertheless easily distinguishable. The ground colour varies from yellowish-brown to purplish-red. There is always a band crossing the wing, broad on costa, narrow on inner margin, rounded on the interior, angulated on the exterior, and a dark wedge-shaped spot at costal apex, which latter is more hooked than in any other species of this genus. The extreme outer edge of outer margin is distinctly white. A very common insect in the hills. Flies over and among grass.

17. EPIAXA SUBIDARIA, *Gn.*

Expanse, 1′ 1″. September and October.

This is also rather a variable insect, at first sight something like *C. vacuaria*. The antennæ of male are, however, plumate

Digitized by Google

in *subidaria*, and simple in the other. The cross-bar also in the present species is bordered outside with white, which is not the case in *vacuaria*. A common insect in the spring.

18. LARENTIA VICISSATA, *Gn.*

Expanse, 1′ 3″. March and April.

A bright-coloured insect, easily distinguished by its orange under-wings and a broad straight silvery bar crossing the fore-wings at three-fourths. The antennæ of male are plumate, those of the female simple, and with this exception the two sexes are alike. A common insect in woods.

19. LARENTIA HELIACARIA, *Gn.*

Expanse, 1′ 1″. April and May.

May be known by four narrow silvery lines crossing fore-wing at regular intervals; the first is round, second slightly angulated, third is sharply zigzaged, and the outer one rounded. The hind-wings are dull reddish-yellow. Common in paddocks.

SUB-FAMILY II.—ÆNOCHROMIDÆ.

Of this sub-family I possess at present 11 species in eight genera, but I have little doubt that there are many more. It contains some of the largest and finest of our Geometrina, but unfortunately these all appear to be rare, and, judging from my own experience, it may be years before the collector meets with them. The fore-wings are more or less hooked at tip, and the antennæ of the males are generally plumate.

1. LAMACHA FLAVICAPITATA, *Gn.*

Expanse, 1′ 3″. September and October.

Ground colour of male grayish-ash colour with a yellow rounded stripe, bordered *inside* with bright red brown across the wings at about one-fourth, another also yellow bordered *outside* with brown at about two-thirds. The yellow head is conspicuous in both sexes. In the female the space between the two lines is filled up with dark brown, which extends outwards some little way past the second line, and gives this sex a very distinct appearance. It is rather smaller than the male, which is unusual, the reverse being generally the case. The male has a distinct black centre spot. Rather a common insect.

2. TAXEOTIS INTEXTATA, *Gn.*

Expanse, 1′. Out all the summer.

An obscurely marked silvery-gray moth. The most prominent markings are, first a row of small round black dots crossing wing at one-fourth, and second a similar row running from costa to anal angle. A common insect.

Digitized by Google

3. TAXEOTIS ARENIFERATA, *Gn.*

Expanse, 1′ 1″. November and December.

A very variable moth, hardly any two being exactly alike. The males are light, and the females dark-brown, and the most constant mark is a line running diagonally across both wings from near costal apex of fore-wing to near the centre of hind margin of hind-wing, although I have specimens in which even this is reduced to a series of dots. The space outside this is generally darker than the rest of the wing, and in some specimens there is also a straight line crossing fore-wing only, at one-fourth from base. A common insect among grass.

4. NEARCHA BUFFALARIA. *Gn.*

Expanse, 1′ 5″. October, January, and February.

An obscurely-marked, although, when fresh, a pretty insect. It flies very fast, and its wings being very thin and delicate, it is difficult to get a good specimen. The ground colour varies from dark-brown to pale-yellowish, but there is always in the male a darker undulating line running from below costa (not from it), at two-thirds, to inner margin. Just inside this are about eight black dots irregularly distributed. These are wanting in the female, in which sex also the line is suffused and more orange-coloured. Not uncommon sitting on the ground among dead leaves.

5. DICHROMODES AINARIA, *Gn.*

Expanse, 1′ 1″. September and October, and again in the autumn.

The fore-wings of this little moth are difficult to describe, but the insect may be known at once by the bright orange under-wings, with deep black border, differing in this respect from any other Geometer I have seen out here. The fore-wings are blackish-brown, with still darker lines and markings. A common scrub insect, but not found in grass paddocks.

6. DICHROMODES OBTUSATA, *Gn.*

Expanse, 1′ 11″. December.

An obscure slaty-gray moth, with all four wings alike. A darker-coloured bar crosses the fore-wing of the male, but the female is almost unicolorous. Pretty common, but from its sluggish habits and dull colour not often noticed.

7. DICHROMODES STILBIATA, *Gn.*

Expanse, 1″ 11″. November, and perhaps December.

I have never yet succeeded in finding this moth in good condition, but the most distinguishing marks appear to be three oblique silvery bars crossing the wing—one near base, the second at three-fourths, and the third along outer margin.

Digitized by Google

The two first slope inwards, the third one outwards. A rare insect in this part.

8. Ænochromia vinaria, *Gn.*

Expanse, two inches. December and January.

When fresh, the thorax, body, and all the wings are of a beautiful purple-red or plum colour, but this soon fades to a yellowish-red. A broad yellow stripe runs from costal apex, which is much hooked, across both wings in a diagonal direction to centre of inner margin of hind wing. There is a black centre-spot, with yellow eye, and an indistinct line near base. The body is very thick and flat, and perhaps a beginner would hardly take it to be a Geometer at all.

Larva, length, 1′ 10″. Prolegs, 6, on 9-10-13 segs.

On the top of back on the eleventh segment are two large raised yellow spots with black circles. On the fourth segment are two hard black pointed horn-like projections with pale yellow bases, and on the sixth segment are two more, but here the horns are barely visible. The spiracles are small, but distinct, and orange coloured. The body is smooth, ground colour brownish-green, darkest above. Belly nearly white. The back is covered with minute white spots, from some of which a short black hair issues, but it requires a lens to see these. Head long and attenuated, reddish-brown in colour. Reposes with the body thrown out perfectly straight from the twig. Is said to feed on Hakea, but I have only found it as yet on Banksia marginata. Not common here.

9. Arhodia lasiocamparia *? Gn.*

Expanse, male, 2′ 2″; female, 3 inches, but varies a good deal in size. November and December.

Colour of all the wings bright yellowish-gray, minutely speckled with darker. A small and sometimes not very distinct centre spot on each wing. Sometimes, especially in the females, the whole of the wings are suffused with pink. This moth may be easily known by a large dark purple blotch on the underside of fore-wing near costal apex. The body is very stout and thick. Antennæ are shortly pectinated in the male, simple in the female. Rather a scarce insect, and there is some doubt as to the name. My insects do not appear to tally exactly with Guenée description, and they may perhaps be an allied species.

Larva, about two inches long, colour greenish-red; quite smooth; spiracles not very distinct. Prolegs on ten and thirteen segments, the latter very broad and flat. A rudimentary pair on ninth segment, but these are not used in walking. Sits stretched straight out from the twig, but when touched it

Digitized by Google

curls the forepart round with the head underneath, like a pastoral crook. On the back of the twelfth segment is a projecting semicircular disk, yellow above, black beneath. Loops very much in walking. It is full fed about the end of February, and passes the winter in the pupa state. Food plant, white gum.

10. PHALLARIA OPHIUSARIA, *Gn.*

Expanse, 2′ 6″, 2′ 11″. March 3rd, 1886.

Wings ample, fore-wings strongly hooked at tip; all the wings pale greenish-brown, with a very distinct ferruginous coloured stripe running from costa, near apex, in a curved direction, across both to centre of inner margin of hind-wings. The inside of this is faintly bordered with yellow. There is also a large white spot with dark border in centre of each wing. Antennæ strongly pectinated in male, thickened only in female. Rare up here—in fact, I have as yet only taken one female. The larva is unknown to me, but is said to feed on Callistemon. I knocked my specimen out of a white gum sapling; it flew slowly and heavily.

11. GASTROPHORA HENRICARIA, *Gn.*

Expanse (male) 2′ 7″. October 29, 1884.

Fore-wings ample costa slightly rounded; apex acute; hind margin straight, oblique. A dark purple bar crosses the fore-wing in the centre from costa to inner margin. The basal half of wing is light yellowish-gray, the posterior half much darker purplish-gray. Thorax and body white. Hind-wings bright orange with a broad deep purple transverse bar, outside of which are eight round purple spots. Antennæ of male very highly plumose and white. I do not know the female nor anything about the larva. My specimen came to light. Mr. Meyrick says that this beautiful insect used to be not uncommon in old collections, but he had never seen a recent specimen except mine.

SUB-FAMILY III.—GEOMETRIDÆ.

Up to the present time I have only obtained two genera with five species of this sub-family, but I know that there are several others. They are mostly green or greenish-gray insects, and appear to be generally distributed, and I doubt if any be really rare.

1. IODIS EXTERNA, *Walk.*

Expanse, 1 inch. November, December.

All the wings bright green, with a small dark spot in centre of each. Collar, costa and cilia crimson. Not very common here; generally considered a scarce insect.

Digitized by Google

2. Iodis vertumaria, *Gn.*

Expanse, 1′ 6″.

This is the largest of the genus known to me. All wings bright green, no centre spot. Collar green, costa and cilia light yellow. A common insect.

3. Iodis dichloraria, *Gn.*

Expanse, 1′ 2″.

All the wings bright green, no centre spot. Collar bright orange, costa and cilia straw-coloured. A very common moth.

4. Iodis carenaria, *Gn.*

Expanse, 11″. March, April.

All the wings bright apple-green. There is a small and rather indistinct purple spot on fore-wing rather below the costa, and a large square red one in centre of hind-wing. Collar, costa, and cilia red. This is the smallest, and in this neighbourhood the rarest of the genus. When fresh it is a very pretty insect.

5. Hypochroma occultaria, *Don.*

Expanse, male, 1′ 7″; female, 1′ 10″. March and April.

A variable insect as to size. I have males only 1′ 2″ across the wings. The upper side of all the wings is a bright silvery-gray, with transverse wavy lines, and a black dash running from the centre of the costa of fore-wing to middle. Underneath the wings are all snow white, with two egg-shaped black spots near base, a larger one beneath centre of costa; a crimson line running from costa half-way across wing, beyond which is a large black smear. The underneath of hind-wings show a deep black border lined with crimson inside. There is also a sharp-edged, triangular, cinnamon-coloured spot that appears to be devoid of scales about the centre of fore-wing, the apex pointing inwards. The antennæ of male are plumose, but running to a point. Those of the female are simple.

Larva.—Length, 2′ 2″. Prolegs appear to exist only on the twelfth and thirteenth segments, but the segments are very crowded together, and the front pair may be on the eleventh. The thirteenth segment is a bifid arrangement running to a point behind, and cleft. No sign of any other prolegs, the belly, even under a lens, appearing smooth and polished. The legs proper are also very small, and nearly invisible when the larva is at rest. The head terminates in a long pointed projection similar to that at the anal end, only it is hard, and not cleft. Colour, all over alike; dull apple-green, with a dull crimson stripe down each side, in which are the spiracles, which are small and black, and up the centre of the belly runs a narrow yellowish-white stripe. Feeds on white gum; holds

Digitized by Google

very hard to the leaf, with the body thrown out straight and rigid. Of course loops very much in walking. Full-fed about the middle of December.

SUB-FAMILY IV.—ACIDALIADÆ.

This sub-family is represented here by only four species, but three at least of these by their great numbers are perfect pests to the collector.

1. Acidalia recessata, *Walk.*

Expanse, 10″. Out all summer and autumn.

All the wings light-grey, with various faint wavy lines. Sits with its wings expanded on leaves, &c. Extremely abundant.

2. Acidalia albicostata, *Walk.*

Expanse, 7″. All the spring and summer.

A small, and when fresh, pretty insect; but it soon fades. All the wings light purplish-red, with a broad light bar beneath costa of fore-wings. I generally beat it from Banksia, but hardly think that is its proper food-plant, or, at any rate, not the only one. The male is much smaller and brighter than the female. Very abundant.

3. Acidalia prosaula, *Meyr.*

Expanse, 8″.

The two sexes are very different looking in this species. The male is generally nearly unicolorous, of a dark olive-brown colour. The female is much lighter and grayer, with a broad transverse band crossing both wings.

A local and rather scarce little insect, that had been overlooked until I took it, and has been as yet only found in this immediate neighbourhood. Flies over and among grass.

4. Acidalia rubraria, *Dbld.*

Expanse, 10″. Flies all the year round, except perhaps in July.

This is the little reddish brown moth that anybody walking through the hill paddocks or scrub kicks up by hundreds. The ground colour is variable, but the markings consist principally of two wavy dark lines across both wings, inside which the colour is lighter. This appears to be constant, whilst other lines vary in almost every specimen.

SUB-FAMILY V.—BOARMIADÆ.

This sub-family appears to be the best represented of any in this neighbourhood, and contains many striking forms. Up to the present I have taken 24 species in fourteen genera. As a rule they are medium or large-sized moths, the greater number

Digitized by Google

occurring in the autumn. Many of the species are very similar to one another, and hard to separate in the perfect state, especially the females.

1. SCIOGLYPTIS CANESCARIA, *Gn.*

Expanse, 1′ 3″. Flies in autumn.

A sombre, dark brown insect, mottled with darker shadings. A broad suffused black band crosses both wings from costal apex of fore to centre of inner margin of hind-wing. Beneath this is a narrow wavy white line. A common Queensland insect, but rare here.

2. SCIOGLYPTIS MUNDIFERA, *Walk.*

Expanse, 1′ 3″. Generally found in autumn, but there is sometimes a spring brood also. Variable.

Somewhat similar to the last, but the ground colour is much paler; the markings and transverse bar have a distinct purplish tinge, and the white line is altogether absent. Most likely not uncommon, but I have as yet secured few specimens, having long confused it with the following species.

3. THALLOGAMA ATTENTA, *Walk.*

Expanse, 11″. April and May, and perhaps in the spring.

In outward appearance very like the last, but besides its smaller size, the antennæ of male, although pectinated, have the pectinations much shorter than in *Scioglyptis*, in which they are very long.

4. ZERMIZINGA INDOCILISARIA, *Walk.*

Expanse, 1′ 3″. April.

Ground colour brown, with various wavy black lines crossing both wings. It may be distinguished from any of the preceding by these lines starting from the costa, and not the apex of the wing, and by the long light-coloured ciliations of the antennæ of the male. The female is semi-apterous. Apparently scarce here, but widely distributed in Australia, and is also found in New Zealand.

5. PHELOTIS COGNATA, *Walk.*

Expanse, 1′. August, also February and March.

Ground colour silvery-gray, with various indistinct black dots and lines crossing the wing from costa to inner margin. The ciliations of the antennæ are very long for about three-quarters of its length, then shorten off rapidly, and the end is simple.

6. PHELOTIS EXCURSARIA, *Gn.*

Expanse, 1′ 6″.

I am rather uncertain about this species, and may have two

Digitized by Google

allied forms mixed together, but the true *P. excursaria* may, I think, be known by the strongly indented outer margin of hind-wings. It is a difficult insect to describe, and the description would read much like some of the preceding, but it is distinct enough to the eye, the ground colour being a kind of bright tawny-brown, and there is one narrow black line running from three-fourths of costa in a zigzag direction to centre of wing, and then turning abruptly is continued towards inner margin. I do not notice this on any of the other species. Rare here, and I am uncertain about date of capture.

7. NERITODES VERRUCATA, *Gn.*

Expanse, 1′ 3″. October, November.

All the wings pale gray, but when quite fresh suffused with a delicate green tinge. The male has a curious round raised spot near base of fore-wing, which, however, is absent in the female. A common insect among grass.

8. AMELORA LEUCANIATA, *Gn.*

Expanse, 1′ 6″. March.

Ground colour pale greenish-brown with nine latitudinal black bars, between each of which are silvery-white ones, also nine in number. The head is yellow and hind-wings light-brown or pale smoke colour. This handsome moth is common most seasons amongst grass, and flies fast.

9. AMELORA GONIOTA, *Meyr.*

Expanse, 1′. March.

Wings silvery gray with a greenish tinge. A very distinct, but narrow black angulated line, crosses the fore-wing at about one-fourth, and another very zigzag one at about three-fourths. There is also a large but indistinct central blotch. A scarce moth, of which I have only as yet taken two or three specimens, and I do not think that it is known elsewhere.

10. AMELORA DEMISTIS, *Meyr.*

Expanse, 1′ 3″. Autumn months.

This is another species that has as yet only been taken here, and I am still uncertain about the exact date, having confounded it with the following species. It is a dull brownish-gray moth, centre spot indistinct, and the transverse lines reduced to rows of dots. It is certainly the most unattractive looking of the genus.

11. AMELORA SPARSULARIA, *Gn.*

Expanse, 1′ 11″. March.

Something like *A. demistis*, but smaller and brighter coloured. The black dots forming the lines are closer together, smaller,

Digitized by Google

and blacker, and there is generally a very distinct centre spot. A common insect, flying among grass.

12. AMELORA AMBLOPA, *Meyr.*

Expanse, 1′ 5″. March.

Ground colour much as in *A. demistis*, but there is a dark rounded line running from costa at four-fifths to inner margin at two-thirds. Outside this the colour is more of a silvery gray. A common moth, but appears to be rather local.

13. EPICOMPSA XANTHOCROSSA, *Meyr.*

Expanse, 8″. March 26th, 1886.

This pretty little insect is in shape a good deal like the English Peacock Moth (*Macaria notata*), to which it is in fact related. My one specimen is the only one known, and it was taken just about daybreak. The general tint of fore-wings is ash colour, but the extreme costal edge is orange, and a narrow stripe of the same colour runs round the hind margin. There are two distinct triangular-shaped black marks on costa, and a series of semicircular ones along the hind margin, which last is highly angulated and dentated. The basal half of hind-wings is gray, the outer half being rich brown; and there is a large round patch of this same colour at anal angle of fore-wings. The genus as well as species is new to science.

14. IDIODES APICATA, *Gn.*

Expanse, 1′ 11″ to 2′. August, January, March.

One of the most variable insects I have met with; hardly two specimens are alike, and there appear to be four distinct types of markings. The fore-wings are sharp-pointed, and strongly hooked at apex, and there is generally a straight diagonal line running from apex across both wings to centre of inner margin of the hind one. In type 1 the ground is greenish, and stripe yellow. In type 2 the ground is reddish-brown, and stripe dark purplish-brown. In type 3 the whole of both wings is suffused with dark purplish-red, forming indistinct smeary blotches; while in type 4—which is by far the rarest—the ground is as in type 1, but on the outside of the yellow line are three large round bluish-black spots, with white centres; the two nearest the apex being nearly confluent. Some years this curious moth may be obtained plentifully by beating gum saplings, but the summer brood is always dwarfed in size, and some years the species appears to be absent altogether.

15. MNESAMPELA PRIVATA, *Gn.*

Expanse, 1′ 6″. March and April.

Fore-wings hooked; yellowish-brown, with a darker shade across fore-wing at half. Hind-wings bright orange. Common

Digitized by Google

16. MNESAMPELA COMARCHA, *Meyr.*

Expanse, 1′ 8″. April.

A good deal like the last superficially, but the ground colour of all the wings is a pale brownish purple. The antennæ of males also show a specific difference, and the insect appears later. This moth seems to be rare.

17. MNESAMPELA FUCATA, *Feld.*

Expanse, male, 2′ 4″. (I have never seen the female). May.

Fore-wings orange, speckled all over with minute purple spots. There are also three larger red spots—one at base, one at centre of wing near base, and the third below costa at about two-thirds. The hind-wings are pale primrose-yellow, without markings. The female is said to be larger and darker than the male. A rare insect everywhere.

18. CRIOMACHA BELIDEARIA, *Feld.*

Expanse, 2′ 1″ to 2′ 5″. May.

Another variable insect, which may be separated into two distinct types, which remain good in both sexes. So distinct are they in appearance that I considered them different species, but Mr. Meyrick thinks otherwise, and so I place them together. In the first the wings are bright brick-red, without any distinct markings; in the other they are pale reddish brown, speckled all over with brownish-purple, and with a more or less distinct darker band across centre of wings. The hind wings are alike in all, reddish-white, inclining to purple on outer margin. Fairly common some years; absent others.

19. CRIOMACHA ERIBOLA, *Meyr.*

Expanse, 2′ 4″. March.

Only one specimen of this species is known, a female, and it is just possible that it may be a very abnormal variety of *belidearia*, but it is such an entirely different looking insect that Mr. Meyrick decided to name it. The fore-wings are dark brown with a yellowish tinge; a black outward curved zigzag line crosses them at one-third, and another, nearly straight, at four-fifths. The thorax is the same colour as the wings, but the crest and head are orange, thus differing from *belidearia*, in all of which the head is the same colour as the wings. The hind-wings are pale yellow, with a deep reddish-brown border. The body is pale yellow.

20. CHLENIAS ARIETARIA, *Gn.*

Expanse, 1′ 5″. March and April.

Fore-wings brown, suffused with silvery-gray in centre. Three narrow black streaks run from near base up the centre

Digitized by Google

of wing, the veins of which are also tinged with black, especially towards outer margin. The hind wings are pearly white. There is a curious hard bifurcated horn-like process on the front of head. A common insect. The male flies slowly just about day-break, but the female often comes to light.

21. CHLENIAS ZONÆA, *Meyr.*

Expanse, 1′ 7″. April.

This species has, I believe, so far only been taken by myself at Balhannah, at any rate it was undescribed. It is larger, darker, and more glossy than *C. arietaria*, and is entirely destitute of the bifurcated horn on the head. The hind wings are sometimes smoke-coloured, sometimes white at base, with dark smoke-coloured margin. My specimens were all bred from the the larva, and I have only twice seen the perfect insect at large, and never on the wing.

Larva.—When full-fed about one inch in length, banded or striped as follows:—Orange stripe down centre of back; then four wavy black lines with bluish-white spaces between; then a broad primrose stripe; then four more black lines, the three last interrupted with space between yellowish white, and then a broad black line. Below this the body is yellow, with four purple wavy lines, spiracles distinct, orange, which latter colour predominates on all the broad stripes towards the head, which is yellow. Body smooth to the eye, but under the lens there are a few sparse black hairs; claspers only visible on the tenth and thirteenth segments. Feeds stretched out on food plant, but on the slightest touch rolls in a ring and drops to the ground. Feeds on Aster axillaris, and is full-fed in September, but although I tried to force them, not one would emerge before middle of April.

22. STIBAROMA MELANOTOXA, *Meyr.*

Expanse, 1′ 5″.

This is a handsome silvery-grey moth, unknown to science until taken by myself. There is a narrow but sharply-defined black line at one-fourth, which is very acutely angulated outwards, and another broader and less acutely angulated at three-fourths. Outside this is a dark blackish smear. Hind wings silvery white, with dark broad border. My specimen is a male; but I possess also a darker insect (a female), that may belong to this species, but the markings are very different, and I am not sure.

23. PARALÆA BEGGARIA, *Gn.*

Expanse, 2′ 1″; female rather larger. April.

All the wings of the male are of a dark grayish-purple, but the hind-wings of female are whitish at base, purple outside.

Digitized by Google

There is a distinct black centre spot in the female, but this is nearly wanting in the other sex. Scarce here, and, I believe, everywhere else, but apparently widely distributed. It is one of the few insects that appear to have a preference for the red gum.

24. DRYMOPTILA TEMENITIS, *Meyr.*

Expanse, one inch. April 7, 1879.

This curious insect is as yet unique, and I have never been able to find a second. Both genus and species are new to science. Fore-wings purplish-gray, with a reddish cross line near base, and a curved and slightly indented black one running from costa at about four-fifths to near the anal angle. The space between this and the outer margin is chocolate-colour. Hind-wings greyish brown.

Digitized by Google

The Lamellibranchs of the Older Tertiary of Australia. (Part II.)

By Professor Ralph Tate, F.G.S., F.L.S., &c.

[Read October 5, 1886.]

Plates XIV., XV., XVI., XVII., XVIII., XIX., XX.

Family Lucinidæ.

Genus Lucina.

SYNOPSIS OF SPECIES.

A. Shell more or less inflated.
  Ornament of concentric lamellæ or striæ.
  Lamellæ thick.
    Quadrately orbicular. *L. leucomomorpha.*
    Obliquely ovate. *L. projecta.*
    Concentrically striated; shell subglobose; margin of valve plain. *L. areæ.*
    Margin of valves crenulated. *L. affinis.*
  Ornament of concentric lamellæ and radial lines.
    Globose with thick lamellæ. *L. nuciformis.*
    Quadrately orbicular, bifid incised radial lines. *L. araneosa.*
    Obliquely ovate. *L. despectans.*
  Ornament of divaricate ridges. *L. quadrisulcata.*
B. Shell compressed.
  Ornament of lamellar folds. *L. fabuloides.*
  Ornament of radial threads and concentric lamellæ. *L. planatella.*

Lucina leucomomorpha, *Tate.*

Reference.—Tran. Roy. Soc., S. Aust., for 1885, t. xii., fig. 7.

Shell quadrately orbicular, moderately convex, subequilateral; umbones small, incurved, contiguous, medial; slightly excavated in front of the umbones, and slightly depressed in the antero-dorsal region; posterior margin truncated; ventral margin convex outwardly. Surface ornamented with numerous regular concentric lamellæ, which are slightly retroflexed at the front.

Lunule cordate, small, rather deep; anterior lateral teeth obscure; right valve with one small cardinal tooth, left valve with two cardinal teeth; ligamental scar linear, submarginal; edge of valve obscurely crenulated.

Dimensions.—Antero-posterior diameter, 11; umbo-ventral

Digitized by Google

diameter, 10·5; sectional diameter of both valves, 6 millimetres.

Locality.—Muddy Creek.

This species has a very strong external resemblance to *Loripes leucoma*, Turton, but is abruptly truncated posteriorly; the surface is lamellately ridged (not striated), and there are no radial striæ; the external ligament removes it generically.

Lucina projecta, *Tate.*

Reference.—Trans. Roy. Soc., S. Aust., for 1885, t. xii., fig. 6.

Shell thin, obliquely ovate, roundly truncated behind, broader with a rounded margin anteriorly; moderately convex. Lunule lanceolate, somewhat deeply depressed. The ornament consists of subacute close-set liræ.

Dimensions.—Antero-posterior diameter, 16; umbo-ventral diameter, 14; sectional diameter, 8 millimetres.

Locality.—Muddy Creek (older beds).

Lucina aræa, *spec. nov.* Plate xix., fig. 9.

Shell orbicular and somewhat oblique, moderately convex, thin, subequilateral; umbones acute, only a little elevated, incurved; lunule small, shortly lanceolate, and slightly sunken. Posterior-dorsal margin is short, straight, and rather sloping; the anterior-dorsal margin being longer, less oblique, and a little concave in front of the umbo; anterior and ventral margins broadly curved, whilst the posterior margin is roundly truncate. Ligament groove on the post-dorsal margin elongate and narrow. The right valve has two cardinal teeth, the front one being small, lateral teeth absent. Margin of valve plain. Surface ornamented with fine concentric striæ.

Dimensions.—Antero-posterior diameter, 8; umbo-ventral diameter, 6; sectional diameter of right valve, 2·5 millimetres.

Locality.—Oyster banks of the Aldinga Cliffs.

Lucina affinis, *spec. nov.* Plate xviii., fig. 11.

Shell subquadrately-rotund, moderately convex, subinequilateral; front-dorsal margin slightly concave, post-dorsal margin longer and sloping; posterior area slightly depressed, which produces a short truncated extremity to the margin; umbones prominently incurved. Margin of valve minutely crenulated. Left valve with two diverging cardinal teeth and developed laterals; ligamental groove on the hinder-dorsal edge long and narrow. Surface ornamented with concentric striæ.

This species is separable from *L. aræa* by its depressed posterior area, crenulated margin of the valves, and the presence of lateral teeth. It also bears an external resemblance to

Digitized by Google

Lucina concinna, Hutton (*Loripes*), but the ornament and some of the interior characters are different.

Dimensions.—Antero-posterior diameter, 6; umbo-ventral diameter, 5·5; sectional diameter of left valve, 1·75 millimetres.

Locality.—Oyster beds of the River Murray Cliffs at Nor'-West Bend.

Lucina nuciformis, *Tate.*

Reference.—Trans. R. Soc., S. Aust., for 1885, t. xii., f. 10.

Shell globose, very thick, regularly convex except in the post-dorsal area, which is abruptly compressed. Surface ornamented with subacute concentric ridges, broader than the intervening sulci, and distant transverse threads more or less obsolete, though usually conspicuous on the dorsal face of the concentric folds. The concentric ridges are usually regularly disposed, but in some individuals they are interrupted by from three to five broadish furrows, variable in width and relative position. Margin of valves, except the hinge-line, strongly crenulated. Lunule small, moderately impressed.

Dimensions.—Antero-posterior diameter, 9; umbo-ventral diameter, 9; sectional diameter, 8 millimetres.

Locality.—Very abundant in the oyster beds of Blanche Point, Aldinga Bay.

L. nuciformis has a general resemblance to *L. columbella*, Lamarck, but its nearest ally in recent creation is *L. crassilirata*, Tate, inhabiting Southern Australia, from which it differs by its greater gibbosity, more angulated behind, and thinner liræ.

Lucina araneosa, *spec. nov.* Plate xx., fig. 13.

Shell quadrately orbicular, subinequilateral, thin, subventricose; umbones acute, approximate, incurved; anterior side slightly produced; lunule moderately large, lanceolate, shallow. Surface ornamented with distant concentric striæ, and incised radial lines repeatedly dichotomous.

Dimensions.—Antero-posterior diameter, 8; umbo-ventral diameter, 7·5; sectional diameter of left valve, 2 millimetres.

Locality.—Muddy Creek, lower beds.

Lucina despectans, *spec. nov.* Plate xx., figs. 15 and 16.

Shell quadrately ovate, subventricose, inequilateral; umbones post-median, acute, incurved, and approximate. Dorsal margin slightly excavated in front, rapidly declining behind; posterior margin truncated; ventral margin arched, rounded in front, forming an obtuse angle where it joins the dorsal inflection.

Surface ornamented with concentric striæ and depressed subacute radiating ridges.

Digitized by Google

Dimensions.—Antero-posterior diameter, 5·5; umbo-ventral diameter, 5; sectional diameter 3 millimetres.

Locality.—Muddy Creek, lower beds.

This little species resembles *L. Tatei*, Angas (P. Z. S., 1878, p. 863), from St. Vincent Gulf, but differs in the style of ornament, and somewhat in form, being particularly less incurved on the antero-dorsal margin.

Lucina quadrisulcata, *D'Orbigny.*

Reference.—Voy. Amérique méridionale, 1847.

Synonyms.—*L. dentata*, auctores, non Wood; *L. divaricata*, auctores, non Linn.; *L. eburnea*, Reeve, Icon. Conch., t. 8, f. 49, 1850; *L. Cumingi*, A. Adams and Angas, Proc. Zool. Soc., 1863, p. 426, t. 27, f. 20.

The fossil which I have illustrated on Plate xii., f. 3, of Part I., under the name of *L. dentata*, does not belong to that species, but to *L. Cumingi*, Adams and Reeve, which in the opinion of Mr. A. H. Cooke (Ann. and Mag. Nat. Hist., Aug., 1886, p. 98) is identical with *L. quadrisulcata*, D'Orbigny.

This species is the largest of the section Divaricella, is more globose in form than the other species, with the divaricating grooves rather more distant, and not denticulated at the margin. It is found living in Ceylon, South Australia, Tasmania, Port Jackson, New Zealand, Gulf of Suez, West Columbia, Panama, and West Indies.

It is fossilized in the oyster beds of the River Murray Cliffs at the Nor'-West Bend; also in the Wanganui Series in New Zealand.

Lucina fabuloides, *Tate.*

Reference.—Trans. Roy. Soc., S. Aust., for 1885, t. xii., fig. 5.

Shell thin, oblong-ovate, compressed; triangular about the umbones, which are ante-median compressed and slightly curved forwards, but not incurved. Antero-dorsal line much incurved in front of the umbo; post-dorsal margin nearly straight, sloping at an angle of about 45°, united to the antero-dorsal side by a graceful curve, with a perceptible truncation posteriorly.

Surface ornamented with sixteen equidistant, erect, thin lamellæ, interspaces concentrically striated; the lamellæ more raised at the front and posterior margins, and the post-dorsal margin is somewhat serrated by them.

Lunule narrow-lanceolate, concave.

Dimensions.—Antero-posterior diameter, 9; umbo-ventral diameter, 7 millimetres.

Localities.—Oyster-banks at Blanche Point, Aldinga Bay; and the gastropod bed of the River Murray Cliffs near Morgan.

This fossil species closely resembles *L. spinifera*, Montagu,

Digitized by Google

of European seas, and *L. fabula*, Reeve, of the Australian and Polynesian seas, with actual specimens of which I have compared it; from *L. fabula* it differs by its fewer concentric ridges, which are thin and elevated, and by the deeper incurvature in front of the umbo; from *L. spinifera* it differs by its fewer concentric lamellæ and more pointed umbones.

Lucina planatella, *Tate.*

References.—Trans. Roy. Soc., Tasmania, for 1884, p. 229; Trans. Roy. Soc., S. Aust., for 1885, t. xii., fig. 11.

Left valve orbicular-ovate, subequilateral, moderately thin, nearly flat. Surface ornamented with regularly disposed concentric, erect, lamelliform ridges of growth, crossed by equidistant radial threads, producing on the dorsal half an open reticulated appearance; towards the front the concentric ridges are coarser, and the radial striæ finer or nearly obsolete. Umbo depressed acute; interior margin of valves smooth.

Dimensions.—Antero-posterior diameter, 33; umbo-ventral diameter, 31 millimetres.

Locality.—Table Cape (*R. M. Johnston!*)

Loripes simulans, *spec. nov.* Plate xiv., fig. 19.

Shell somewhat triangularly orbicular, subequilateral, thin rather inflated; umbones produced incurved; antero-dorsal margin conspicuously concave, post-dorsal margin about as long and sloping; posterior margin roundly truncated. In young shells the anterior side is somewhat produced. Margin of valves minutely crenulated. Surface ornamented with distant, slightly elevated, concentric lamellæ. The left valve has two small diverging cardinal teeth; the right valve with one cardinal tooth, and in each valve there is a post-lateral tooth; cartilage groove wholly internal, descending obliquely from behind the cardinal area.

Dimensions.—Antero-posterior diameter, 6·25; umbo-ventral diameter, 6; sectional diameter, 4 millimetres.

Locality.—Oyster banks, Aldinga Cliffs.

Differs from *L. icterica*, Reeve, in the well-developed concentric ridges, and in the absence of radial striæ, in which respect it agrees with *L. assimilis*, Angas. From the latter species, which I have not seen, it seems to differ by its coarser concentric ornament and inflated umbones.

Cryptodon mactræformis, *spec. nov.* Plate xix., fig. 5.

Shell minute, very thin, triangularly ovate, inequilateral, moderately convex, semipellucid, white, shining. The sculpture consists of very fine striæ of growth. Umbones small, only a very little elevated above the dorsal line, acute, situated somewhat in advance of the middle. The posterior side is a little

Digitized by Google

produced, being a little longer than the anterior, and is acuminate behind. The dorsal margins are straight and very sloping, especially the posterior, which is a little longer than the anterior; the ventral margin is regularly curved.

Dimensions.—Antero-posterior, 3·5; and umbo-ventral diameters, 2·75 millimetres.

Locality.—Lower beds at Muddy Creek.

FAMILY UNGULINIDÆ.

Diplodonta subquadrata, *spec. nov.* Plate xiv., figs. 10*a*—10*b*.

Shell quadrately-orbicular, moderately convex, thin, translucent, inequilateral, equivalve; posterior side broad, with a subtruncated margin, anterior side narrower and rounded. The ornament consists of rather coarse concentric lines of growth, with here and there broader ones. Umbones small, antemedian, acute.

Dimensions of an average size specimen:—Antero-posterior diameter, 13; umbo-ventral diameter, 11·5; sectional diameter, 9 millimetres.

Localities.—Muddy Creek (lower beds); oyster-beds of the River Murray Cliffs at Nor'-West Bend; Table Cape, Tasmania (*R. M. Johnston!*)

The nearest ally of this species is *D. Tasmanica*, T. Woods, from which it differs by its more quadrate outline and regular sculpture, and in being less inequilateral; it closely resembles, also, *D. Zealandica*, Gray, which is more inflated, and has a rounded ventral margin.

Sacchia suborbicularis, *spec. nov.* Plate xviii., figs. 10*a*—10*c*.

Shell triangularly orbicular, depressed, rather solid; posterior side rounded, somewhat produced anteriorly. Umbones small, obtuse, produced, approximate; lunule obsolete, margins of valves simple. Surface marked with distant growth-folds, smooth at the umbones.

The left valve has two divergent cardinal teeth; the anterior one is stout and triangular, the posterior one is thin and elongate, behind which is a broad and deep triangular cartilage groove. In the right valve there are two cardinal teeth separated by a triangular pit, which receives the strong anterior tooth of the left; the anterior tooth is confluent with the dorsal edge, but the posterior is elongate, narrowly triangular, grooved on the face, and free from the dorsal edge; there is a cartilage groove corresponding with that in the left valve. No lateral teeth. Pallial line entire.

Dimensions.—Antero-posterior diameter, 7·5; umbo-ventral diameter, 8; sectional diameter, 3·75 millimetres.

Digitized by Google

Locality.—Oyster-beds of the River Murray Cliffs at the Nor'-West Bend.

It is with some hesitation that I refer this little species to *Sacchia*, as I have had no opportunity of examining an authentic species of this genus, also because of the great resemblance it bears externally to the lenticular species of *Diplodonta*, particularly *D. Adamsi* and *D. Jacksonensis*, Angas; but the dentition and the broad cartilage pit are not those proper to *Diplodonta*.

FAMILY ERYCINIDÆ.

Leptum crassum, *Tate.*

Reference.—Trans. Phil. Soc., Adelaide, 1879, t. 5, f. 9, p. 130.

A thick transversely-oval shell.

Locality.—Gastroped bed of the River Murray Cliffs, near Morgan.

Lepton planuisculum, *Tate.*

Reference.—Op. cit., t. 5, f. 12, p. 130.

A thin quadrately-ovate shell, with a produced umbo.

Locality.—Oyster beds of the Aldinga Cliffs.

Kellia micans, *spec. nov.* Plate xix., fig. 13.

Shell minute, inequilateral, rather thick, convex; umbones small, depressed; anterior side somewhat produced; posterior side shorter, roundly truncated at the extremity; the dorsal margin is considerably oblique on both sides; there is no lunule. Surface smooth and shining, and ornamented with concentric striæ; alternating bands of varying width of opaque white and bluish-slate colour. Left valve with one small cardinal denticle, in front of which is a stout laminar tooth; there is also a faint short lateral tooth on the posterior side.

Dimensions.—Antero-posterior diameter, 3; umbo-ventral diameter, 2·5; sectional diameter of left valve nearly 2 millimetres.

Locality.—Muddy Creek.

Montacuta sericea, *spec. nov.* Plate xiv., fig. 6.

Shell transversely ovate, moderately depressed, very inequilateral, rather solid, glossy, and sculptured with very fine lines of growth. The umbones are small, curved over towards the front, slightly produced, and situated at about one-fourth of the total length from the anterior end. The anterior-dorsal margin is short, oblique; imperceptibly excavated before the umbo, then gradually rounding into the sharply-curved extremity; the post-dorsal margin is much longer, at first almost horizontal and straight, afterwards a little arched and oblique. The ventral margin is nearly horizontal. The left valve has

Digitized by Google

two divergent laminar teeth, one on each side of a broad triangular cartilage pit, of which the posterior is large and oblique, and the anterior very small. The right valve has a lamellar projection of the dorsal margin on either side of the cartilage-fossula.

Dimensions.—Antero-posterior diameter, 6·5; umbo-ventral diameter, 5; sectional diameter, 3 millimetres.

Localities.—Upper beds at Muddy Creek; oyster beds of the River Murray Cliffs at the Nor'-West Bend.

FAMILY CHAMIDÆ.

Chama lamellifera, *Tenison-Woods.* Plate xiv., figs. *5a*—*5b*.

Reference.—Proceedings of Royal Society of Tasmania for 1876, p. 114.

Surface of both valves ornamented with distant, thin, irregular, sometimes projecting lamellæ. The lamellæ are finely radiately ridged and striated; interspaces between the lamellæ concentrically striated. Rarely exceeding 20 millimetres of diameter.

Localities.—Table Cape (*R. M. Johnston!*); older and younger beds at Muddy Creek; clays at Schnapper Point; well sinking, Nine-Mile Camp, near Nor'-West Bend; clayey sands, Adelaide bore.

Chamostrea albida, *Lamarck.*

Reference.—Animaux sans Vertebres, vol. vi., p. 96, 1819.

Synonym.—*C. crassa*, Tate, Proc. Roy. Soc., Tasmania, for 1884, p. 228.

I do not hesitate to refer an example of a large valve obtained by Mr. Dennant from the Muddy Creek beds to the above-named species of the peculiar Australian genus. A left valve collected by Mr. R. M. Johnston at Table Cape was erected by me into a distinct species, but I think now on insufficient grounds.

Right very convex, keeled, attached by its anterior side; umbo anterior subspiral; left valve flat; surface smooth, with distant growth-lines. About two inches diameter.

FAMILY VERTICORDIIDÆ.

Verticordia rhomboidea, *spec. nov.* Plate xiv., fig. 4.

Considerably inflated, rhomboid, very inequilateral. Umbo inflated, much curved over towards the front, and situated quite at the anterior end; the ventral margin nearly straight, the dorsal margin arched, making with the straight posterior margin an obtuse angle; anterior margin at first concave, forming a rounded somewhat produced angle with the ventral margin.

Digitized by Google

Surface ornamented with thin, angular, elevated, curved, radial ribs, 24 in number, eight of which occupy the abruptly sloping post-umbonal area, insterstices wider than the ribs; the whole surface crossed by thin distant concentric liræ, which produce serratures on the radial costæ.

Lunule deep and broadly cordate.

Interior pearly, ribbed towards the ventral and posterior margins corresponding with the exterior sulcations; anterior and posterior margins thin, crenulated.

Right valve with a tooth-like callosity under the lunule, and a long laminar lateral tooth on the posterior side.

Dimensions.—Antero-posterior diameter, 5; umbonal ventral diameter, 5; sectional diameter of right valve, 2·25 millimetres.

Locality.— Calciferous sandstone, with gastropods, River Murray Cliffs, near Morgan.

Verticordia pectinata, *spec. nov.* Plate xiv., fig. 13.

Triangularly ovate, slightly convex; anterior side somewhat produced and rounded; umbo small, curved towards the front, situated a little behind the middle line; front dorsal margin concave, post-dorsal margin convex, gibbous; ventral margin slightly arched medially, rapidly ascending posteriorly to the subacuminate extremity. Ornamented with twelve broad, rounded, radial undulations about equal in breadth to the concave furrows; the whole surface minutely granular, which is produced by the intersection of radial and concentric striæ. Interior of left valve pearly, edentulous; ventral margin of valve thin, broadly crenulated.

Dimensions.—Antero-posterior diameter, 3·5; umbo-ventral diameter, 3 millimetres.

Locality.—Lower beds at Muddy Creek.

FAMILY CARDIIDÆ.

Genus Cardium.

SYNOPSIS OF THE SPECIES.

Whole surface ornamented with more or less similar radial ribs.

A. Valve rotundly-quadrate.
Ribs, 50, flat, and smooth. *C. pseudomagnum.*
Ribs, 70, flat, and smooth; those on the posterior slope with small tubercles. *C. septuagenarium.*
Ribs, 60, flat, granulated on the margins. *C. moniletectum.*

B. Valve ovate, oblique; 65 ribs. *C. Victoriæ.*

C. Valve trapezoidal. *C. cuculloides.*

Digitized by Google

Radial ridges on the posterior slope only, rest of surface radially and concentrically striated. *C. antisemigranulatum.*
Anterior half of valve cancellated, the posterior half with spinulose ribs. *C. hemimeris.*

Cardium pseudomagnum, *McCoy.*

Reference.—Pal. Victoria, Decade v., t. 44, f. 1, 1877.

"Rotundly quadrate; ribs 50, sub-equal, flat, smooth, without spines or marked striæ, and separated by very narrow sulci, their ends strongly toothing the internal margin. Length of the antero-posterior diameter, 90 millimetres. *Locality.*—Very abundant in the sandy beds, Bird Rock Bluff, near Geelong."—*McCoy.*

Cardium moniletectum, *spec. nov.* Plate xiv., figs. 3*a*.—3*b*.

Rotundly quadrate, slightly oblique, subequilateral, ventricose; ventral margin moderately convex; posterior slope flattened, becoming a little convex dorsally, its margin straight, nearly perpendicular; post-dorsal margin nearly straight, slightly ascending; front dorsal margin straight, a little sloping, joining somewhat abruptly the flatly rounded anterior margin. Umbo inflated, moderately oblique, and a little in front of the centre.

Ribs, about 60, equal, flat, smooth, shining, minutely, closely and regularly granulated on the margins; intervening sulci very narrow and deep. Margin of valves strongly toothed.

Dimensions.—Antero-posterior diameter, 38; umbo-ventral diameter, 40; sectional diameter through closed valves at about half the length from the umbo, 31 millimetres.

Locality.—Abundant in the clayey green sands, Adelaide bore.

Cardium septuagenarium, *spec. nov.*

Shell of about the same size and shape of *C. moniletectum*, but with about 70 flat, smooth, slender ribs, those of the posterior slope crowned with small tubercles; the intervening sulci nearly as broad as the ribs, shallow, and transversely finely striated.

Localities.—Table Cape *(R. M. Johnston!)*, and in a well-sinking at Nine-Mile Camp, near Nor'-west Bend, River Murray Plain.

Cardium Victoriæ, *spec. nov.* Plate xiv., figs. 1*a*—1*b*.

Shell longitudinally ovate, somewhat heart-shaped, rather depressed, slightly oblique, subequilateral. Ornamented with about 65 delicate, flattish, radial costæ; costæ with distant decurrent serratures on their sides, those on the anterior side with elevated, thick, distant, annular scales or tubercles; six

Digitized by Google

or seven costæ on the posterior slope tuberculated; the intervening sulci are about as wide as the ribs.

Umbo obtuse, incurved, with a slight forward projection. The front and post-dorsal margins about equally sloping; the posterior area is flattened, its margin obliquely truncated.

Margin of the valves crenulated.

Dimensions.—Antero-posterior diameter, 15; umbo-ventral diameter, 16; sectional diameter of a single valve at about one-third the length from the umbo, 5 millimetres.

Locality.—The older beds at Muddy Creek, near Hamilton, Victoria.

Cardium cucullöides, *Tate.*

Reference.—Trans. Roy. Soc., S. Aust., for 1885; plate xii., fig. 14.

Shell thin, smooth, trapezoidal, oblique, tumid, inequilateral; umbones oblique, incurved, narrow, considerably in front. Anterior margin rounded; ventral margin nearly straight, oblique to the hinge line; posterior margin obtusely truncated; posterior slope flattened, separated from the moderately convex rest of the valve by an obtusely-rounded ridge; dorsal line arched.

Surface ornamented by equidistant, incised radial lines, about one millimetre apart at the front; in the umbonal region the sulci are about half the width of the flat ridges; on the lateral areas the sulci, though narrow, are deep and obliquely striated; the flat ridges are marked in the middle line by a slight groove widening out at irregular intervals into elliptical depressions. Inner margin of valve flatly ribbed.

Dimensions.—Longitudinal diameter, 32; length from umbo to posterior angle, 31; width, 30; thickness through both valves, 20 millimetres.

Locality.—Muddy Creek (*J. Dennant!*).

This remarkable species may be placed in the section *Papyridæ* of Swainson.

Cardium antisemigranülatum, *McCoy.*

Reference.—*Protocardium antisemigranulatum*, McCoy, Pal. Victoria, Decade v., t. 44, figs. 2-3, 1877.

Quadrately-oval, gibbous; umbo elevated, incurved, and directed forwards; posterior slope with acute radial ridges, closely set with conical tubercles; rest of the surface regularly, concentrically, and radially striated.

Dimensions.—Antero-posterior diameter, 40; umbo-ventral diameter, 42; sectional diameter of a single valve, 16 millimetres.

Localities.—Rare at Moorabool (*McCoy*); very rare in the older beds at Muddy Creek (*J. Dennant!*).

Digitized by Google

Cardium hemimeris, *spec. nov.* Plate xiv., figs. 2*a*—2*c*.

Shell thin, quadrately-oval, subglobose, inflated; umbones elevated, incurved, submedian; dorsal margin slightly arched; posterior margin truncated, a little incurved towards the lower rounded angle; posterior area flattened, very steep. The anterior half of the surface of the valve is ornamented by numerous regular, equal, flat riblets, crossed by finer and closer concentric threads, which are somewhat irregularly disposed, being here and there somewhat undulose and confluent;* the intersection of the riblets and the liræ produce a tessellated ornament. The posterior half is ornamented with about 50 flat, narrow riblets, closely beset with small tubular, conical spines. Margin of the valves strongly toothed.

Dimensions.—Antero-posterior diameter, 13; umbo-ventral diameter, 14; sectional diameter of both valves, 10 millimetres.

Localities.—Very common in the clayey green sands, Adelaide bore; rather rare and of small size in the older beds at Muddy Creek; in a deep well-sinking, Cooke's Plains, east of Wellington, River Murray.

FAMILY UNIONIDÆ.

The generic references to the following species were made by the original describer purely on external resemblance, which is of no value. As *Anodonta* is not actually known either recent or fossil in Australia, and *Unio* is, it will be more consistent therefore to place all our fossil Unionidæ, so long as the hinge characters are unascertained, in the latter genus.

Unio Tamarensis, *R. Etheridge, jun.*

Reference.—*Anodonta Tamarensis*, Eth., Roy. Soc., Tasm., for 1880, p. 22, figs. 3-4.

Older Tertiary beds of the Tamar River, Launceston, on the authority of Mr. R. M. Johnston.

Transversely elongate, about twice as long as broad; posteriorly acuminated, anterior side very short, convex, and very gibbous; length, nearly four inches.

Unio Johnstoni, *R. Etheridge, jun.*

Reference.—Op. cit., p. 20, figs. 1, 2.

Same locality as the last.

Obliquely oval, compressed; breadth, about one-third less than the length, which is three and a-half inches.

* The fig. 2*b* incorrectly represents the concentric sculpture.

Digitized by Google

FAMILY VENERIDÆ.

Genus Chione.

SYNOPSIS OF THE SPECIES.

A. Lamellæ thin, erect.
  a. Lamellæ distant, interspaces concentrically striated.
    Shell ovately-oblong, anterior side subangulated; lamellæ, about twelve. *C. Allporti.*
    Anterior side rounded; lamellæ numerous. *C. multilamellata.*
  b. Lamellæ distant, interspaces with radial riblets.
    Cordately ovate, ventricose. *C. hormophora.*
    Ovately-oblong, less inflated. *C. dimorphophylla.*
  c. Lamellæ crowded; cordately ovate. *C. Cainozoica.*
B. Lamellæ thick, or concentrically ridged.
  Trigonal, with fifteen lamellæ. *C. subroborata.*
  Transversely oval, with twenty or more ridges, radially striated. *C. propinqua.*
C. Surface with radial riblets, decussated by concentric striæ. *C. dictua.*
D. Surface smooth, concentrically grooved. *C. Corioensis.*

Chione Allporti, *Tenison-Woods.*

Reference.—*Venus Allporti*, Tenison-Woods, Proc. Roy. Soc. Tasmania for 1875, p. 26, t. 3, f. 10.

Ovate, oblong, depressed; anterior side very short, its margin somewhat angulated; ornamented with twelve concentric appendiculate lamellæ, and concentric striæ; the ventral aspect of the frills is slightly vertically wrinkled. Margin of the valves minutely crenulated.

Dimensions.—Antero-posterior diameter, 30; umbo-ventral diameter, 22 millimetres.

Locality.—Table Cape (type in Hobart Mus.!)

This fossil differs from the living *C. lamellata* by its more oblong outline, the post-dorsal and ventral margins being nearly parallel, whilst the anterior margin is more rapidly descending, and the ventral margin not so arched; the umbo is more anterior, and the frills are simple, and about twice the number.

Chione multilamellata, *spec. nov.* Plate xv., figs. 6*a*—6*b*.

Ovately-oblong, thin, moderately convex; umbones antemedian, inflated, curved forwards; anterior margin rounded, posteriorly roundly truncated; ventral margin regularly arched; post-dorsal margin slightly arched, more rapidly sloping than the shorter, nearly straight front dorsal margin. Lunule broadly cordiform, much raised along the middle line, and sculptured with fine lamellæ of growth.

The surface is closely lamellated, concentrically lirate and

Digitized by Google

substriated in the interstices, and radiately striated, more conspicuously so on the posterior and anterior sides; the lamellæ are about 40 in number, thin, elevated, and radially ribbed and striated on the ventral aspect.

Margin of the valves from the umbo to the post-ventral angle minutely crenulated. Siphonal inflection very short, broadly triangular.

Dimensions of a moderate-sized specimen.—Antero-posterior diameter, 38; umbo-ventral diameter, 30; sectional diameter through both valves, 22 millimetres.

Localities.—Abundant in the Turritella clays at Blanche Point, Aldinga Bay, and in the clayey green sands in the Adelaide bore.

C. multilamellata bears considerable resemblance to *Venus oblonga*, Hanley, but is not so rounded posteriorly and the lamellæ are higher and thinner.

Chione hormophora, *Tate.* Plate xv., figs. 1*a*—1*b*.

Reference.—Proc. Roy. Soc., Tasmania, for 1884, p. 230.

Shell solid, cordately-ovate, inflated; truncately rounded in front, truncated behind; ventral margin arched; post-dorsal margin strongly arched, antero-dorsal margin straight. Surface ornamented with numerous concentric lamellæ thickened and recurved, becoming erect and thin towards the posterior and anterior margins; the interstitial spaces with numerous flattish radial ridges, about equal in breadth to the intervening sulci, which are continued on to the bases of the concentric folds, and to the the free margin of the frills on their undersides. Lunule cordate, not much impressed under the umbo, and indistinctly margined. The umbo is in the anterior-fifth, large, incurved, and directed forwards. Inner margin of valves, excepting that of the post-dorsal region, is minutely crenulated. Posterior cardinal tooth in left valve is quadrate and bituberculated on the crown. Pallial sinus short, broadly triangular, apex acute.

Dimensions.—Antero-posterior diameter, 65; umbo-ventral diameter, 57; sectional diameter of left valve, 22 millimetres.

Locality.—Table Cape (*R. M. Johnston!*)

Chione dimorphophylla, *Tate.* Plate xv., figs. 3*a*—3*b*.

Reference.—Proc. Roy. Soc., Tasmania, for 1884, p. 230.

Similar to *C. hormophora*, but is more regularly rounded at the front, is less inflated, the umbo placed more posteriorly; the lunule is more impressed and concave; and the relative dimensions are different.

Dimensions.—Antero-posterior diameter, 58; umbo-ventral diameter, 45; sectional diameter of both valves, 32 millimetres.

Digitized by Google

Localities.—Common in the calciferous sandstone of the River Murray Cliffs, near Morgan; and in the older beds at Muddy Creek, near Hamilton.

Chione Cainozoica, *Tenison-Woods.* Plate xvi., figs. 3*a*—3*b*.

Reference.—Proc. Roy. Soc., Tasmania, for 1876, p. 113.

Suborbicular, inequilateral, globosely convex. Ornamented with closely set, thin, concentric lamellæ; those on the middle portion scarcely elevated; more elevated on the front, and imbricating posteriorly. Umbones convex, much incurved, and directed forwards; lunule broadly heart-shaped, prominent, and very distinctly circumscribed by a groove which interrupts the concentric lamellæ, the fine ends of which form the only ornamentation of the lunule.

The whole anterior and ventral margin finely crenulated. Pallial sinus very short, narrowly triangular, apex acute.

Dimensions.—Antero-posterior diameter, 22; umbo-ventral diameter, 20; sectional diameter of closed valves at about a third the length from the umbo, 14 millimetres.

Localities.—Table Cape (*R. M. Johnston !*); lower beds at Aldinga and Adelaide bore; middle Murravian beds near Morgan and Nine-mile Camp; lower beds at Muddy Creek clays at Schnapper Point, Port Phillip Bay.

Chione subroborata, *spec. nov.* Plate xiv., fig. 17.

Cordately-trigonal, solid, much broader in front than behind, where it is subrostrate, thick, moderately convex; flattened in the umbonal region. Umbones small, recurved, and situated considerably in front of the middle line. Surface glossy, ornamented with concentric lamellæ (about 15) and striæ; the lamellæ are rather thick, recurved, except on the posterior slope, where they are erect.

The ventral margin is broadly curved, slightly insinuate towards the posterior end; the post-dorsal line is oblique, arched behind the umbones, then straighter, prolonged, and much descending; the front-dorsal line is excavated.

The lunule is small, broadly cordate, and lamellate sculptured. The margin of the valves is very finely crenulated. Pallial line distant from the margin; the inflection rather shallow, broadly triangular, subacute at the apex.

Dimensions.—Antero-posterior diameter, 25; umbo-ventral diameter, 24; umbo to post-ventral angle, 25; sectional diameter of both valves, 14 millimetres.

Localities.—Common in the upper beds at Muddy Creek; oyster beds at Nor'-West Bend; calciferous sandstone at Mordialloc.

This species comes very near to *C. roborata*, Hanley, but the lamellæ are fewer and thinner; it is less produced anteriorly,

Digitized by Google

with a straighter post-dorsal slope, and more pointed behind. It agrees with *C. Isabellæ* in the number and strength of the lamellæ, but is otherwise different.

Chione propinqua, *Tenison-Woods*. Plate xiv., figs. 7 and 8.

Reference.—Proc. Roy. Soc., Tasmania for 1876, p. 113.

Transversely oval, umbo a little in front of the centre; anterior end broadly rounded; posterior side a little attenuated, its margin roundly truncated. Ornamented with many (more than 20) raised rounded concentric ribs, becoming lamellar at the extremities; ribs and the narrower interspaces are concentrically striated; the interspaces crossed by transverse broadish riblets, equal in width to the intervening spaces. Margin of the valves finely crenulated. Pallial line near the margin, the siphonal inflection rather shallow, narrowly triangular, rounded at the apex.

The species varies somewhat in shape and in the number and thickness of the concentric ribs; fig. 8 represents the typical form, fig. 7 represents a more oblong and narrower shell, whilst others are more attenuated than the type, even becoming subrostrated.

Tenison-Woods compares his species with the existing *C. conularis*, but the greater affinity is with *C. mesodesma*, Quoy and Gaimard, from which it differs most conspicuously by the coarser radial ornamentation.

Dimensions of the type.—Antero-posterior diameter, 24; umbo-ventral diameter, 19; sectional diameter of one valve, 6 millimetres.

Localities.—Table Cape (*R. M. Johnston!*); lower and upper beds at Muddy Creek, but common in the latter only.

Chione Corioensis, *spec. nov.* Plate xvi., fig. 1.

Sub-quadrately ovate, sub-depressed, inequilateral; umbo small, situated in the anterior third; anterior side narrowed, abruptly rounded; posterior side broader, and obliquely rounded at the end; the post-dorsal margin is horizontal and straight; ventral margin much ecurved. Lunule ill-defined.

Surface smooth and shining, with distant linear concentric sulci, the intervening flat sub-imbricating interspaces, becoming thread-like at the front and the two extremities; a few indistinct fine radial corrugations appear towards the antero-ventral margin. Angulated lines of colour are visible in the umbonal and median regions. Margin of valves plain.

Dimensions.—Antero-posterior diameter, 7·25; umbo-ventral diameter, 6·75.

Locality.—In the calciferous sandstone at Corio Bay, Geelong.

This species bears a strong resemblance to the young of

Digitized by Google

C. strigosa, but is proportionately shorter, the concentric ridges are flat, and not at all undulose.

Chione dictua, *spec. nov.* Plate xvi., fig. 2.

Transversely-oblong, inequilateral, rather depressed, broadly rounded in front, narrowed and obliquely truncate behind. Umbo acute, incurved, directed forward, situated in the anterior third; dorsal margin about equally sloping on both sides, straight behind, and feebly concave in front of the umbo. Surface ornamented with flat closely-set riblets somewhat irregular in thickness, but always wider than the linear interspaces, and decussated by concentric striæ and raised threads, more distant from each other than are the radial riblets, the concentric threads acquire the form of thin slightly elevated lamellæ at the two extremities. Lunule lanceolate, slightly concave, and medially elevated, sculptured with fine lamellæ of growth and circumscribed by a deep groove. Margin of valves, except post-dorsal, finely crenulated.

Dimensions.—Antero-posterior, 10; umbo-ventral, 7; and sectional diameter of both valves, 3·5 millimetres.

Locality.—Oyster beds of the River Murray Cliffs at Nor'-West Bend.

C. dictua has some affinity to *C. striatissima* and to young examples of *C. gallinula*, but the shape is different, and the sculpture very much finer.

Genus Cytherea.

SYNOPSIS OF SPECIES.

A. Lamellate rugæ on the posterior slope.
- Transversely-ovate, acuminated posteriorly. *C. paucirugata.*
- More triangular, truncated behind. *C. Murrayana.*

B. Smooth.
- Transversely-oval, somewhat produced and truncated behind. *C. tenuis.*
- Ovately-trigonal, rounded behind. *C. eburnea.*
- Oval, subacuminated posteriorly. *C. submultistriata.*

Cytherea paucirugata, *spec. nov.* Plate xiv., fig. 14.

Transversely-ovate; somewhat acuminate at both ends, especially behind; very inequilateral, moderately convex, thick; the front-dorsal slope is straightish, or a little incurved at the lunule, and much more descending than the post-dorsal margin, which is at first broadly curved, finally narrowly obliquely truncated; the ventral margin is widely arched, but is indistinctly sinuated in front of the post-ventral angulation.

The umbones are small, approximate, situated about one-

Digitized by Google

fourth of the entire length of the shell from the anterior end. The lunule is narrow-lanceolate, ill-defined, faintly circumscribed, and slenderly striated. The exterior of the valves is somewhat shining, coarsely concentrically striated, and bears a few remote concentric ribs, which are raised into scale-like lamellæ at the front margin and on the posterior slope, appearing on the latter in two rows, corresponding with the two obscure ridges, which proceed from the umbo to the angles of the posterior truncation. Ventral margin finely crenulated.

Dimensions.—Antero-posterior diameter, 39; umbo-ventral diameter, 30; sectional diameter of both valves, 21 millimetres.

Locality.—Very common in the younger beds at Muddy Creek, Hamilton.

This species closely resembles the living *Callista Victoriæ*, Tenison-Woods (=*Chione rutila*, Hanley), from which it differs by being proportionately longer, by the more acuminate and biangulated posterior extremity, by the flatter posterior slope, which is usually ornamented with two rows of elevated scales.

Cytherea Murrayana, *spec. nov.* Plate xiv., fig. 18.

Perhaps only an extreme form of *C. paucirugata*, nearly as broad as long; more widely truncated, and not at all acuminated posteriorly; the scale-like lamellæ small and developed on the anterior and post-dorsal margins only; the posterior slope is more angulated, and the lunule is much wider and deeper. Faint and distant radial threads are here and there visible on the surface.

Dimensions.—Antero-posterior diameter, 32; umbo-ventral diameter, 29 millimetres.

Locality.—Oyster beds of the River Murray Cliffs at Nor'-West Bend.

Cytherea tenuis, *spec. nov.* Plate xiv., fig. 16.

Transversely-oval, thin, moderately convex, inequilateral, a little narrower in front than behind, where it is somewhat truncated. The umbo is rather small incurved, situated at about one-fourth of the whole length from the front. The post-dorsal margin is elongate, nearly straight, the anterior being much shorter, more descending, and slightly curved; the ventral outline is gently arcuate, ascending more in front than behind. The lunule is broadly lanceolate, shallow, striated, and circumscribed by an impressed line. The exterior surface is shining, very finely concentrically striated.

The margin of the valves is plain.

The pallial sinus is large, broad, deep, obliquely ascending, extending to the centre of the valve, abruptly rounded at the end.

Digitized by Google

Dimensions.—Antero-posterior diameter, 27; umbo-ventral diameter, 20; sectional diameter of both valves, 13 millimetres,

Locality.—In the clayey green sands, Adelaide bore.

Cythera eburnea, *spec. nov.* Plate xviii., fig. 7.

Ovate-subtrigonal, inequilateral, rather thin and convex, sub-acuminate anteriorly, and bluntly rounded posteriorly. The umbones are rather small, moderately acute, curved over towards the front, situated at about one-third of the whole length from the front. The dorsal margin descends considerably on both sides, the anterior nearly straight, the posterior much longer, and slightly arched; the ventral outline is gently curved, ascending much more in front than behind. Lunule, large, broadly cordate, scarcely sunken, a little elevated along the middle, circumscribed by an impressed line, and striated by growth lines.

The exterior is smooth, shining, white, marked at intervals with narrow subtranslucent zones, and ornamented with a few incised lines and striæ, developing into raised threads at the extremities.

The pallial sinus is moderately deep, obliquely ascending, and sharply rounded at the end.

The margin of the valves is plain.

Dimensions.—Antero-posterior diameter, 16; umboventral diameter, 13; sectional diameter of both valves, 10 millimetres.

Localities.—Common in the older beds at Muddy Creek, and in the calciferous sandstone of the River Murray Cliffs near Morgan; also in the yellow sand rock, Corio Bay; in the blue clays at Schnapper Point, Port Phillip; Table Cape (*R. M. Johnston!*).

Cytherea submultistriata, *spec. nov.* Plate xviii., figs. 6 and 8.

Transversely elongate-ovate, moderately convex, thick; anterior side shorter; posterior side subacuminately produced. Surface with distant growth folds and finely concentrically striated. Lunule lanceolate, shallow, defined by an impressed line. The pallial line is much nearer to the margin than in allied species; the sinus is wide and deep, reaching to the centre of the valve; it is obliquely narrowly truncated at the end.

Dimensions.—Antero-posterior diameter, 30; umbo-ventral diameter, 22; sectional diameter of both valves, 14 millimetres.

Localities.—Upper beds at Muddy Creek; variety (fig. 6), in a well-sinking, Cooke's Plains, east of Wellington, River Murray.

Digitized by Google

This species resembles the living *C. multistriata*, Sow., *C. disrupta*, Sow., and *C. Diemenensis*, Hanley; in its oval outline it comes nearest to *C. multistriata*, but its post-dorsal margin is straight, and the pallial line and sinus are different, being like those in *C. disrupta*.

The variety (fig. 6), of which only one specimen has been obtained, makes some approach to *C. eburnea;* it is shorter and more convex than the type, but is connected with it by two examples from Muddy Creek.

Genus Dosinia.

synopsis of species.

Regular concentric ridges.	
Valve flat; ridges thick, depressed.	*D. Johnstoni.*
Valve rather tumid; ridges thin, erect.	*D. Grayii.*
Inequidistant concentric sulcations.	*D. imparistriata.*

Dosinia Johnstoni, *spec. nov.* Plate xiv., figs. 9 and 12.

Orbicular, lenticular, moderately convex, somewhat thin and glossy, inequilateral.

Umbones moderate, curved forward, and situated at about one-fourth of the whole length of the valve from the front. Lunule ovately-cordate, short, impressed, elevated in the middle, very finely striated.

The exterior is ornamented with concentric ridges, which are regular, numerous, thick, depressed, with reflexed acute edges, and separated by linear deep sulci (about 20 in a breadth of 10 millimetres, measured from the ventral margin); at the extremities the liræ are fewer, and are here and there raised into more or less elevated scales. The posterior hinge area somewhat angulated and lamellated.

The pallial sinus is triangular, with a broad base, extending horizontally to a little beyond the middle of the valve; apex acute.

Dimensions.—Antero-posterior diameter, 27; umbo-ventral, 25; sectional diameter of one valve, 7 millimetres.

Localities.—Upper beds at Muddy Creek, Hamilton; Table Cape (*R. M. Johnston!*)

Dosinia Grayii, *Zittel.*

Reference.—Pal. von Neu-Seeland, p. 45, t. 15, f. 11; *id*, Hutton, Tertiary Moll. of N. Zealand, p. 22, 1873.

"Orbicular, solid, tumid, sub-æquilateral, with distant concentric lamellæ, more elevated at the extremities. Umbos inflated, incurved, acute. Anterior side sloping, rounded posteriorly; lunule large, oblong-cordiform, deeply impressed,

Digitized by Google

striated, circumscribed by an acute edge. Pallial sinus triangular, apex acute."—*Zittel.*

Dimensions.—Antero-posterior and umbo-ventral diameters, 60; sectional diameter of united valves, 40 millimetres.

Locality.—Yellow limetone of the sea cliffs at Edithburgh on west side of St. Vincent Gulf; also the Pareora and Wanganui formations, New Zealand.

This identification is based on the comparison with an authentic specimen of the species.

Dosinia imparistriata, *spec. nov.* **Plate xiv., fig. 11.**

Orbicular-cordate, rather gibbous, somewhat thin and glossy, inequilateral. Umbones rather large, curved forward, and situated at about one-third of the whole length from the front. Lunule short and narrow, medially elevated, ornamented with imbricating lamellæ.

The exterior is ornamented with linear concentric sulci at variable distances from one another; at the extremities the interspaces are raised into thickish, but little elevated lamellæ. The posterior hinge area is somewhat flatly rounded.

The pallial sinus is broad, obliquely ascending to a little beyond the middle of the valve, apex obtuse.

Dimensions.—Antero-posterior diameter, 13; umbo-ventral diameter, 12; sectional diameter of one valve, 4.

Locality.—Clayey green-sand, Adelaide bore.

This species is remarkable for the inequidistant concentric sculpture.

Meroe gibberula, *spec. nov.* **Plate xv., figs. 4*a*—4*b*.**

Ovate-cordate, subequilateral, slightly convex, and rather swollen behind the umbo; thick, polished; umbo acute, directed forwards, a little in front of the centre; posterior side broader and truncately rounded, anterior side produced, acuminately rounded. Margin of the valves closely and finely crenulated.

Dimensions.—Antero-posterior diameter, 28; umbo-ventral diameter, 23; sectional diameter of united valves, 13 millimetres.

Locality.—Common in the upper beds, Muddy Creek.

This species very closely resembles the living *M. Aliciæ*, Angas, from which it differs by being more gibbous in the post-dorsal region, and in consequence of which the escutcheon is much broader; it is, moreover, not so truncated on the posterior margin, which is not quite so long.

FAMILY PETRICOLIDÆ.

Venerupis paupertina, *spec. nov.* **Plate xiv., fig. 15.**

Shell ovate-oblong, moderately convex; anterior side short, somewhat acuminately rounded; posterior side truncated, ob-

Digitized by Google

tusely angled from the umbo to the post-ventral border; ventral and post-dorsal margins straight, almost parallel. Umbo conspicuous, incurved; lunule small, but well defined.

Surface with somewhat distant and irregularly disposed concentric lamellæ, slightly crenated and foliated, especially on the posterior slope, and rayed with rather distant flat ribs, equal in width to the interspaces. Hinge of right valve with three cardinal teeth, widely and equally separated; the anterior one short and stout, the others very prominent and simple; the ligamental lamella extends to more than half the length of the post-dorsal line. Pallial sinus small, rounded, horizontal.

Dimensions.—Length, 12; height, 7; thickness through both valves, 5 millimetres.

Localities.—Upper beds at Muddy Creek, Hamilton; and oyster beds of the River Murray Cliffs at the Nor'-West Bend.

This species has a great resemblance to *V. exotica*, Lamarck, but the umbo is larger and more cordate; the posterior margin is narrower, the post-dorsal area is more defined, and the radial ribs are flat, and not angular; internally further differences are presented by the cardinal teeth and the elongate ligamental lamella. In its flat ribs and cordate umbo, the fossil resembles *V. mitis*, Desh., but is in other respects different.

Genus Tellina.

synopsis of species.

A. Siphonal inflection confounded with the pallial line.
- Elongate, hardly compressed, posteriorly subrostrated. *T. lata.*
- Oval, compressed, posteriorly sub-angular. *T. albinelloides.*
- Oblong, posteriorly short and cuneiform. Umbo in posterior one-fourth; ventral margin nearly straight. *T. porrecta.*
- Umbo in posterior one-third; ventral margin arched; lamellate *T. Masoni.*
- Triangularly-ovate, compressed, posteriorly flexuous and obsoletely carinated *T. Cainozoica.*

B. Siphonal inflection detached from the pallial line.
- Oval-oblong, nearly equilateral; somewhat smooth. *T. equilatera.*
- Elongate oval; inequilateral; concentrically ridged. *T. Stirlingi.*

Digitized by Google

Tellina Cainozoica, *T. Woods*. Plate xviii., fig. 5.

Reference.—Proc. Roy. Soc. Tasmania for 1876, p. 113.

Ovate-oblong, equivalve, inequilateral, very compressed and thin; anterior end rounded, posterior end sub-rostrated, not inflected; posterior carina inconspicuous and very close to the margin; umbos small, obtuse, antemedian. Surface ornamented with very fine and close growth-lines, and equidistant thin, erect, inconspicuous lamellæ. Interior unknown.

Dimensions.—Antero-posterior diameter, 24; umbo-ventral diameter, 15; intersection of the diameters at 11·5 from the anterior end; sectional diameter, 5.

Locality.—Table Cape, Tasmania (*R. M. Johnston!*)

This species, uniquely represented, so closely resembles *T. alba*, Quoy and Gaimard, of the same size, actual specimens of which from the Wanganui series in New Zealand have been under observation, as to suggest the probability of its being merely an individual variation of that species. However trivial the distinctive characters are, yet should they hereafter be found constant, the claim to specific rank will be fairly well established.

It differs from *T. alba* in its more central umbo, not so acutely angular posteriorly, and by the presence of raised growth-lines.

Tellina lata, *Quoy* and *Gaimard*.

Reference.—Voy. de l'Astrolabe, t. 81, figs. 8-10, vol. 3, p. 497 (1835).

Locality.—Oyster-banks or the superior fossiliferous beds in the cliffs of Aldinga Bay.

Dimensions of the largest example.—Antero-posterior, 125; umbo-ventral, 75; sectional diameter, 28.

I have little hesitancy in referring the fossils to the living species inhabiting North Australia and the Indo-Pacific regions, despite the fact they are somewhat imperfectly preserved, and have not been compared with actual specimens.

Tellina albinelloides, *spec. nov.* Plate xvi., figs. 4*a*—4*b*.

Oval, subequilateral, very compressed, thin, pellucid, anterior side rounded, posterior side produced, subangulated, and slightly folded. Umbones inconspicuous, acute, directed backward, and situated a very little in front of the centre. The exterior is ornamented with fine, regular, concentric striæ, which are raised into thin, narrow, imbricating lamellæ on the angulated posterior slope.

Dimensions.—Antero-posterior diameter, 44; umbo-ventral diameter, 22; sectional diameter through closed valves, 5·5 millimetres.

Locality.—Common in the upper beds at Muddy Creek.

Digitized by Google

The fossil shells are not readily separable from *T. albinella*, inhabiting Southern Australia, with which they agree in dentition and in the broad deep pallial inflection, the posterior line of which is confluent with the pallial impression. In its adult stage *T. albinelloides* is about the same size of ordinarily full-grown examples of *T. albinella*; but it is more decidedly inequivalve, the right valve being markedly depressed, especially in the posterior half, in consequence of which greater prominence is given to the small subacute umbo. The breadth is proportionately less, and therefore the front dorsal slope is less arched; the post-ventral margin does not ascend so rapidly, which with the straighter front dorsal margin impart a contour sufficiently distinctive to be of specific value. The young shells of each differ in the following particulars:—In *T. albinella* the posterior side is narrow and more rostrated, in *T. albinelloides* it is broader, abruptly arched, and shortly rostrated.

The ornament is equally variable in the fossil as in the living analogue.

Tellina porrecta, *spec. nov.* Plate xvi., fig. 8.

Transversely-elongated, very inequilateral, the anterior side three times as long as the posterior; narrowed and sharply rounded in front, cuneiform behind; moderately convex. The ventral margin is broadly rounded at the middle and front, incurved posteriorly. Surface ornamented with fine distant concentric liræ, which are more pronounced on the posterior slope. Dentition unknown.

Dimensions.—Antero-posterior diameter, 9·25; umbo-ventral diameter, 4·5; sectional diameter of one valve, one millimetre.

Locality.—Green sands, Adelaide bore.

Tellina Masoni, *spec. nov.* Plate xvi., figs. 6*a*—6*b*.

Transversely-oblong, rather convex, inequilateral, the anterior side twice as long as the posterior. Front-dorsal margin elongated, hardly oblique, slightly arched; post-dorsal margin rapidly descending, straight, and narrowly truncated at the extremity; ventral margin arched anteriorly and towards the posterior side inconspicuously incurved. The left valve is feebly concavely depressed behind the posterior carination.

The exterior surface is ornamented by closely-set, thin, very slightly elevated concentric lamellæ. There are two cardinal teeth in each valve, and well-developed laterals in the right. Pallial sinus very large, reaching to near the anterior adductor scar.

Dimensions.—Antero-posterior diameter, 18; umbo-ventral diameter, 11; sectional diameter of both valves, 6 millimetres.

Locality.—Rare in the older beds at Muddy Creek.

Digitized by Google

It is with much pleasure I associate with the species the name of the proprietor of the land on which the chief fossiliferous deposits of Muddy Creek are found; also because of his hospitality and assistance rendered to all visitors in search of fossils.

Tellina æquilatera, *spec. nov.* **Plate xvi., figs. 5*a*—5*b* and 9*a*—9*b*; plate xx., fig. 19.**

Ovate-oblong, subequilateral, rather thick, smooth, and somewhat convex. Post-dorsal margin straight, a little more descending than in front, which is slightly incurved; front margin broadly rounded; posterior side narrower, abruptly and narrowly rounded at the extremity. There is a slight radial depression near the post-dorsal margin, proceeding from the umbo, which produces an inconspicuous insinuation at the posterior extremity. The umbones are small, acute, and situated a very little in front of the centre.

The exterior is ornamented with fine incised concentric lines and zones of colour. The siphonal inflection is very deep, narrow, rounded at the extremity, reaching to near the anterior adductor scar, and is quite detached from the pallial impression.

The left valve has one bifid cardinal tooth; the right valve with two cardinal teeth, the posterior one much larger and bifid; a strong lateral tooth on each side, the anterior one being nearer to the cardinal teeth.

Dimensions of a medium-sized example:—Antero-posterior diameter, 52; umbo-ventral diameter, 35; sectional diameter of left valve at three-sevenths from the umbo, 8·5 millimetres.

Locality.—Upper beds at Muddy Creek; calciferous sandstone, River Murray Cliffs, near Morgan.

Plate xx., fig. 19, represents an adult example from Muddy Creek; plate xvi., fig. 5, an averaged-size specimen, also from Muddy Creek; plate xvi., fig. 9, is a young shell from the River Murray Cliffs—the figure, however, is not correct, being too much angled posteriorly, and too much arched ventrally.

Tellina Stirlingi, *spec. nov.* **Plate xvi., figs. 7*a*—7*b*.**

Elongate-oval, considerably inequilateral, rather thin, subpellucid, and somewhat convex; the anterior side is half as long again as the posterior, narrowed and subacuminately rounded behind. Surface ornamented concentrically with slender, not crowded, subacute ridges, and a few broadish furrows.

There are two cardinal teeth in each valve, and well-developed laterals in the right. The siphonal sinus is large, rounded, ascending into the umbonal cavity, reaching to mid-

Digitized by Google

way between the adductor scars, and is quite free from the pallial line.

Dimensions.—Antero-posterior diameter, 10; umbo-ventral diameter, 6; sectional diameter of both valves, 3·5 millimetres.

Locality.—Not uncommon in the lower beds at Muddy Creek.

Species-name in compliment to Mr. James Stirling, F.G.S., F.L.S., who has so ably described the physiographic features of the Victorian Alps in a long series of papers communicated to several Scientific Societies.

Strigilla australis, *spec. nov.* Plate xix., fig. 6.

Oval, compressed, thin, shining, inequilateral, the posterior side being the longer; umbo small, acute. The sculpture consists of incised lines, which, as regards direction, are grouped in three distinct regions—(1) On the anterior side they are transverse, more or less coincident with the margin, becoming (2) oblique on the median portion, those nearest the front being abruptly bent, the included angle widening towards the umbones; (3) the narrow post-dorsal area is covered with numerous oblique striæ, interrupted by the posterior lines of the middle region, and making with them acute angles, directed ventrally. The umbonal region has concentric striæ only. The left valve has one bifid cardinal tooth and an approximate lateral denticle on each side.

Dimensions.—Antero-posterior diameter, 9·5; umbo-ventral diameter, 7·5 millimetres.

Locality.—Lower beds at Muddy Creek.

Psammobia Hamiltonensis, *Tate.* Plate xvi., fig. 13.

Reference.—Southern Science Record, January, 1885, p. 4.

Shell shining, compressed; transversely elliptical, attenuated anteriorly, and obliquely truncated posteriorly; sculptured with incised lines concentric with the margin, which become rugæ on the angulated posterior area.

The fossil closely resembles the living *P. zonalis*, Lk., from which it differs in being narrower, more attenuated anteriorly, and less abruptly truncated posteriorly. The post-dorsal line is not so straight, and the post-ventral margin is a little more ascending, so that the posterior margin is more attenuated and less abruptly truncated; the anterior margin is also more produced.

Dimensions.—Antero-posterior diameter, 31; umbo-ventral diameter, 15 millimetres.

Localities.—Common in the upper beds at Muddy Creek, Hamilton (*R. T.*); Table Cape (*R. M. Johnston!*)

Digitized by Google

Psammobia æqualis, *Tate*. **Plate xvi., fig. 10.**

Reference—Southern Science Record, January, 1885, p. 4.

Shell compressed; umbo central, depressed; transversely elliptic; attenuated anteriorly; roundly truncated posteriorly; sculptured with concentric closely arranged raised lines.

Dimensions.—Antero-posterior diameter, 22; umbo-ventral diameter, 11 millimetres.

Localities.—Upper beds at Muddy Creek; Middle Murravian series near Morgan, on the River Murray (*R. T.*); Table Cape (*R. M. Johnston!*).

This species differs from *P. Hamiltonensis* by the absence of a posterior keel. Its representative in living creation is the British *P. tellinella*, Lk., from which it differs by its central and depressed umbo, compressed valves, more attenuated anterior margin, and rounded posterior margin.

Donax Dixoni, *spec. nov.* **Plate xvi., fig. 15.**

Triangularly ovate, subequilateral, the posterior side being a little longer, flatly convex; posterior margin obliquely truncated, anterior side acuminately rounded. Umbones a little oblique, small, situated a little in front of the centre.

Surface ornamented by broad flatly rounded radial ribs, which are wrinkled by concentric striæ and grooves; on the posterior slope the costæ are not much wider than the intervening sulci; but on the post-medial area the sulci are linear; the radial costæ become obsolete on the anterior side.

Ventral margin of the valves coarsely crenulated.

Dimensions.—Antero-posterior diameter, 10; umbo-ventral diameter, 6·5; sectional diameter of one valve, at about the middle, 2 millimetres.

Locality.—Lower beds at Muddy Creek.

Species-name in compliment to Mr. Samuel Dixon, my companion on many geological excursions.

The species has much resemblance to *D. cardioides*, Lamarck, but is not abruptly inflated medially.

Donax depressa, *spec. nov.* **Plate xvi., fig. 11.**

Broadly triangularly ovate, very inequilateral, rather depressed, but abruptly and sharply elevated from the umbo to the post-ventral angle; posterior side depressed and roundly truncated at the extremity; anterior extremity sub-acuminately rounded. The ventral margin is nearly straight, but is inconspicuously incurved in front of the keel.

The surface of the anterior portion is almost smooth, finely radially and distantly concentrically grooved; granulately wrinkled on the keel; radially and concentrically finely ridged on the depressed, flat posterior area.

Digitized by Google

Margin of the valves plain.

Dimensions.—Antero-posterior diameter, 37; umbo-ventral diameter, 25; sectional diameter of one valve, 6 millimetres.

Locality.—Oyster beds at Nor.'-West Bend, River Murray.

FAMILY SEMELIDÆ.

Semele vesiculosa, *spec. nov.* Plate xvi., fig. 12.

Transversely ovate, inequilateral, somewhat inflated. The anterior side is the longer and rounded, the posterior side is obtuse angled; slightly inequivalve, the right valve not so convex as the other, and less inconspicuously angled at the umbonal slope; umbones acute, approximate, situated a little behind the centre; front dorsal margin slightly incurved in front of the beaks; post-dorsal margin slightly arched, with a considerable descending slope; ventral margin broadly arched at the front and middle, slightly insinuated posteriorly. Lunule broadly lanceolate, hardly impressed.

Exterior surface, glossy, white, with a few growth lines.

Left valve with one cardinal tooth in front of and rather distant from the short narrow oblique cartilage pit, sometimes with a small short lamina arising from the distal end of the cardinal tooth and directed backwards. Right valve with two divergent cardinal teeth in front of the cartilage pit. There is a well-developed lateral on each side. The pallial sinus is wide, broadly rounded at the apex, and extending for two-thirds across the interior.

Dimensions.—Antero-posterior diameter, 9; umbo-ventral diameter, 6; sectional diameter of both valves, 5 millimetres.

Locality.—Not rare in the lower beds at Muddy Creek.

Var., with longer posterior side and more pointed extremity common in the calciferous sandstones of the River Murray Cliffs near Morgan.

Semele Krauseana, *spec. nov.* Plate xvi., figs. 18*a*—18*b*.

Transversely-oval, inequilateral, thin, moderately convex; the valves a little unequal, both are turned conspicuously to the right at the hinder end, and there slightly gaping. The anterior side is the longer and rounded, the posterior subrostrated, with a slight fold continued from the umbo to the post-ventral margin. The umbones are very small, acute, contiguous, situated at four-sevenths of the whole length from the front; lunule lanceolate concave. The dorsal margins are straight, the hinder more rapidly sloping than the front; the ventral margin is broadly arched anteriorly, slightly incurved, and rapidly ascending posteriorly. The exterior surface is shining, white, with one or two zones of colour; concentrically finely striated.

Digitized by Google

Dimensions.—Antero-posterior diameter, 21; umbo-ventral diameter, 12; sectional diameter of closed valves, 7 millimetres.

Localities.—Clays at Schnapper Point, Port Phillip; lower beds at Muddy Creek; calciferous sandstone of the River Murray Cliffs near Morgan.

Professor McCoy, in Report Geol. Surv., Victoria, No. 2, figures on p. 22, under the name of *Tellina Krausei*, the impression of a Tellina-like shell obtained near Stawell, and states that the species is common in the Tertiary beds at Schnapper Point. It may possibly be *Semele Krausеana*, with which it agrees in shape, but doubtfully so, as the drawing indicates an ornamentation of thick concentric ridges, unless, however, it be faulty in this particular. The figure is unaccompanied by description.

The species-name is in compliment to Mr. F. M. Krausé, F.G.S., Lecturer on Geology at the Ballarat School of Mines, and late of the Geological Survey of Victoria.

FAMILY MACTRIDÆ.

Genus Mactra.

SYNOPSIS OF THE SPECIES.

Broadly ovately-trigonal; subacuminately produced posteriorly; wavy wrinkled at the sides. *M. axiniformis.*

Shorter and broader; posterior side straight; concentric striæ simple at the sides. *M. Hamiltonensis.*

Elongate-ovate, attenuated at the extremities. *M. Howchiniana.*

Mactra axiniformis, *spec. nov.* **Plate xvii., figs. 1*a*—1*b*.**

Ovately trigonal; thickish, rather tumid, inequilateral, bluntly rounded in front, the posterior side the longer and sub-acuminately produced. Ventral margin broadly arched, inconspicuously insinuated towards the posterior extremity; dorsal margins about equally sloping, the front a little arched, the posterior one longer, at first slightly ecurved, thence straight. The surface is shining, brown with zones of lighter colour; almost smooth in the medio-dorsal region; the rest of the valve ornamented with concentric slender growth-ridges and striæ; the ridges are fewer, thicker, and wrinkled on the anterior angulation, those on the posterior carination are obliquely striated.

The pallial line is very broad and near the margin, the siphonal inflection is horizontal, rounded at the end, and extends to a little more than one-fourth the distance between the adductor scars.

Digitized by Google

Dimensions.—Antero-posterior diameter, 42; umbo-ventral diameter, 29·5; sectional diameter of united valves, 20 millimetres.

Locality.—Common in the upper beds at Muddy Creek.

This species has the aspect of *M. rufescens*, Lamarck, a well-known shell inhabiting the temperate regions of Australia, from which it differs by being more attenuated in front and behind, proportionately longer, and having finer ornament.

Mactra Hamiltonensis, *spec. nov.* Plate xvii., figs. 4*a*—4*b*.

Ovately elongate, subequilateral, slightly convex, thin, shining. The anterior side is rather shorter than the posterior, the former is broader and obtusely rounded at the end, the latter is narrowed towards the end, where it is sharply rounded.

The ornament consists of thin elevated growth lines, which are here and there confluent one with another.

The pallial sinus is sharply rounded at the end, and reaches a third of the length across the valves.

Dimensions.—Antero-posterior diameter, 23; umbo-ventral diameter, 18; sectional diameter of united valves, 9 millimetres.

Locality.—Common in the upper beds at Muddy Creek.

This species is the analogue of the living *M. polita*, Chemnitz, of Southern Australia, from which it differs by its flatter valves and less triangular outline, being proportionately longer and the ventral margin not so broadly curved.

Mactra Howchiniana, *spec. nov.* Plate xvii., figs. 3*a*—3*b*.

Oblong, attenuated at both extremities, inequilateral, thin, shining. The anterior side is shorter and narrower than the posterior, the front-dorsal margin is slightly concave, the post-dorsal slightly arched; the ventral margin is almost straight medially, but ascends more rapidly behind than in front.

The surface is concentrically finely ridged and striated.

The lateral teeth are transversely wrinkled on the dorsal face. The pallial sinus is rather broad, rounded at the apex, confounded with the pallial line, and extends about half-way across the valve.

Dimensions.—Antero-posterior diameter, 41; umbo-ventral diameter, 23; sectional diameter of both valves, 12 millimetres.

Locality.—Rare in the lower beds at Muddy Creek. Young shells not uncommon in the calciferous sand-rock of the River Murray Cliffs, near Morgan; rare in the clays at Schnapper Point, Hobson Bay.

The specific name is in compliment to Mr. Walter Howchin, F.G.S., who has elaborated for the author the Foraminifera of the Older Tertiary beds of Australia.

Digitized by Google

Zenatiopsis angustata, *Tate.*

Reference.—Trans. Roy. Soc., S. Aust., 1879, p. 129, t. 5, fig. 6.

Externally like the living *Zenatia acinaces*, Quoy and Gaimard, but is narrower, more attenuated posteriorly, and the anterior side is longer and not so abruptly arched; internally it differs by the presence of a thick rib descending vertically from the umbo.

Localities.—Gastropod-bed of the River Murray Cliffs near Morgan; upper and lower beds at Muddy Creek; Table Cape (*Hobart Mus.!*)

FAMILY PAPHIIDÆ.

Anapa variabilis, *spec. nov.* Plate xvii., figs. 5*a*—5*b*.

Ovately-trigonal, rather thin, inequilateral; umbones inflated, antemedian; posterior side the longer, bluntly rounded at the extremity; the anterior end is rounded, and the front-dorsal slope slightly incurved. The surface is ornamented with moderately fine growth ridges and striæ.

Dimensions.—Antero-posterior diameter, 17·5; umbo-ventral diameter, 13·5; sectional diameter of united valves, 11 millimetres.

Locality.—Common in the oyster banks of Blanche Point Cliff, Aldinga Bay.

The figured example fairly represents the mean of extremes of form assumed by this species, which is closely related to *A. cuneata* and *A. triquetra*; from which it differs by its greater gibbosity, rounded posterior extremity, and the convex not flattened posterior slope. Some very young examples are triquetrous, and with difficulty separable from *A. triquetra* at the same stage of growth.

FAMILY ANATINIDÆ.

Thracia perscabrosa, *spec. nov.* Plate xv., fig. 5.

Right valve moderately convex, ovately-oblong, narrowed in front and broadly truncated behind; umbones post-median; posterior area concavely depressed, separated from the rest of the valve by a rounded carination extending from the umbo to the post-ventral angle. The post-dorsal margin is nearly straight, nearly parallel with the ventral margin; the front dorsal margin is somewhat ecurved and oblique. The anterior end is rather wedge-shaped, and rounded at the extremity; the posterior end is abruptly truncated, forming a rounded angle with the ventral margin, and an obtuse angle (about 105 deg.) with the dorsal margin; the ventral margin is very little curved, ascending in front.

Digitized by Google

The posterior area is coarsely granulated, the rest of the surface less so; conspicuous folds of growth occur at irregular intervals.

Dimensions.—Antero-posterior diameter, 33; umbo-ventral diameter, 21; sectional diameter of right valve, 7 millimetres.

Localities.—Muddy Creek (lower beds)—a right valve only; Adelaide bore, a left valve, probably of the same species.

Among recent species this fossil shell is much like *T. speciosa*, Angas, but is less inequilateral, and more attenuated at the front.

Genus Myodora.

synopsis of the species.

A. Elongate, subinequivalve.

Anterior side five times as long as the posterior; broadish. *M. prælonga.*

Anterior not much longer than the posterior; very narrow. *M. angustior.*

B. Right valve convex; left valve flat.

Right valve oblong; finely concentrically ridged, radially striated. *M. tenuilirata.*

Right valve ovately-oblong, with numerous close concentric ridges. *M. australis.*

Right valve ovate, with few distant concentric ridges. *M. corrugata.*

Right valve triangularly ovate, somewhat acuminate anteriorly; left valve truncated posteriorly. *M. lamellata.*

? ? ; left valve equilaterally trigonal. *M. æquilateralis.*

Myodora prælonga, *spec. nov.* Plate xix., figs. 12*a*—12*d*.

Elongately-oblong, thickish, inequivalve, very inequilateral, the anterior side being about five-sixths the total length, anteriorly rounded and posteriorly vertically truncated. The front dorsal slope is slightly convex, the post-dorsal margin incurved behind the umbo, ventral margin almost straight, and horizontal; the post-dorsal slope is bluntly angulated.

The surface of the valves is smooth, with concentric growth lines.

The pallial sinus is broad, rounded at the end, and extends to nearly half the length of the shell.

The right valve is moderately convex, the other is depressed, almost flat.

Dimensions.—Antero-posterior diameter, 14; umbo-ventral diameter, 7·5; sectional diameter of right valve, 2·25 millimetres.

Digitized by Google

Locality.—Upper beds at Muddy Creek.

This Thracia-like species is very similar to and has the same interior characters as *Alicia angustata*, Angas, but is more robust and broader.

Myodora angustior, *spec. nov.* **Plate xvi., fig. 16.**

This species is related to the last, but is less inequilateral, and is much narrower than the allied species *M. angustata;* the concentric ridges are more pronounced, and the post-umbonal angulation is almost obsolete. The pallial sinus, which is strap-shaped, extends across to the anterior adductor scar as in *Alicia elegantula*, Angas; but the shape of that species is very different.

Dimensions.—Antero-posterior diameter, 10; umbo-ventral diameter, 4·5 millimetres.

Locality.—Upper beds at Muddy Creek.

Myodora tenuilirata, *spec. nov* **Plate xvii., figs. 9*a*—9*b*.**

Transversely elongate-oblong, thin, inequilateral, somewhat acuminately rounded in front, abruptly truncated behind. Right valve moderately convex; post-dorsal margin nearly straight, much longer than the front-dorsal margin, which makes with it an angle of about 150 deg.; posterior margin vertically truncated; ventral margin very gently curved, except towards the anterior, where it rapidly ascends. Conspicuously carinated from the umbo to the post-ventral angle. Surface ornamented with close-set, fine, concentric ridges, crossed by radial wavy microscopic thread-like lines. Left valve flat, a little concave in the umbonal region, with a few concentric lines, but the radiating minute threads more conspicuous and crowded than on the other valve.

Dimensions.—Antero-posterior diameter, 16; umbo-ventral diameter, 10; sectional diameter of both valves, 3 millimetres.

Localities.—Victoria: lower beds at Muddy Creek; Corio Bay; Schnapper Point. S. Australia: Turitella grits at Ardrossan; oyster beds of the River Murray Cliffs at Nor'-West Bend; gastropod beds near Morgan.

Among living species *M. tenuilirata* has a general resemblance to *M. pandoræformis*, Stutchbury, but it differs from it by being less convex, more produced posteriorly, its post-dorsal margin straighter, its ventral margin less arched, and by its more numerous concentric ribs. The fossil congener, *M. australis*, is easily separable from it by its shape.

Myodora australis, *Johnston.* **Plate xvii., figs. 10*a*—10*b*.**

Reference.—Proc. Roy. Soc., Tasm., for 1879, p. 40.

Ovately-oblong, inequilateral, thick, anterior side the

Digitized by Google

shorter, with a rounded extremity, posterior side abruptly truncated at the end. Right valve moderately convex, faintly ridged from the umbo to the post-ventral angle; concentrically ridged, the ridges about equidistant, and as broad as the concave interspaces, about ten in the space of five millimetres from the medial ventral margin.

Left valve flat or slightly convex, inconspicuously concavely depressed in the post-dorsal region, ornamented with concentric striæ, and radiating microscopic thread-like lines.

Dimensions.—Antero-posterior diameter, 17; umbo-ventral diameter, 13; sectional diameter of both valves, 5·5 millimetres.

Localities.—Table Cape (*R. M. Johnston !*); lower beds at Muddy Creek.

This species has more affinities with *M. ovata*, Reeve, than any other living, but it is more oblong with more numerous and closer concentric ridges on the convex valve, whilst the flat valve is concentrically striated and not plicated.

Myodora corrugata, *spec. nov.* **Plate xvii., figs. 11*a*—11*b*.**

Ovate, somewhat triangular, thick; ornamented with few, subdistant, thick, rounded, concentric ridges. It is extremely like *M. ovata*, Reeve, but has fewer concentric ridges.

Dimensions.—Antero-posterior diameter, 18; umbo-ventral diameter, 14·5; sectional diameter, 4 millimetres.

Localities.—Not uncommon in the upper beds at Muddy Creek; oyster banks, Government House quarry, at Adelaide.

Myodora lamellata, *spec. nov.* **Plate xvii., figs. 6*a*—6*c* and 7.**

Trigonally-ovate, rather solid, subequilateral, anteriorly rather acuminate; posterior margin scarcely truncated to somewhat acuminately produced and sinuated. Right valve very convex, depressed down the posterior side; the dorsal margins about equally sloping and slightly incurved, the anterior rather more arcuated; ventral margin moderately arched, abruptly curving upwards anteriorly. Ornamented with thickish, regular, somewhat elevated concentric ridges, with broader interspaces.

Left valve flat, with finer sculpture.

Dimensions.—Antero-posterior diameter, 9; umbo-ventral diameter, 8; sectional diameter, 4 millimetres.

Localities.—Clayey green sands, Adelaide bore; and Turritella clays, Blanche Point, Aldinga Bay.

In its somewhat rounded form and very convex right valve, *M. lamellata* is related to *M. convexa*, Angas, inhabiting New Caledonia; but apart from differences in outline, the fossil

Digitized by Google

species is distinguished by the coarser and more distant liration.

Myodora æquilateralis, *Johnston*. Plate xvii., fig. 8.

Reference.—Proc. Roy. Soc., Tasmania, for 1879, p. 40.

Left valve solid, trigonal, equilateral, flat, or slightly concave; dorsal margins equally sloping, inclined to one another at an angle of 90 deg.; the front-dorsal margin straightish, or slightly arched; the post-dorsal margin straight, or slightly incurved behind the umbo; ventral margin roundly arched. Right valve unknown.

Surface ornamented with close, fine concentric ridges of growth and striæ and microscopic granules, the former forming nodulose denticulations on the front-dorsal edge.

Dimensions.—Antero-posterior diameter, 25; umbo-ventral diameter, 21 millimetres.

Localities.—Table Cape (*R. M. Johnston!*); Schnapper Point, Hobson Bay (*R.T.*); upper beds at Muddy Creek (*J. Dennant!*).

FAMILY CORBULIDÆ.

Corbula ephamilla, *Tate*. Plate xvii., figs. 13*a*—13*b*, and 14.

Reference.—Proc. Roy. Soc., Tasmania, for 1884, p. 229.

Shell solid, very inequivalve, inequilateral, ovately-triangular, rounded anteriorly, beaked posteriorly. Right valve with more than twenty very thick, rounded prominent concentric ridges, the whole surface striated concentrically. The ventral margin is outward-curved medially, and the ridges have a corresponding flexure. The posterior margin is obliquely truncated, carinated from the umbo to the post-ventral margin; posterior to the carina is a somewhat concave area on which the concentric folds are continued as multiplied lamellæ. The umbo is in the anterior third, flat, incurved, and with small ridges. Left valve ovately triangular, nearly flat, pointed behind, carinated from the umbo to the post-ventral margin; surface irregularly striated by lines of growth; umbo flattish, from below which two distinct ridges radiate to the ventral margin, one or two additional but shorter ones sometimes occur. Young shells distantly radially striated, the striæ more prominent and closer on the posterior slope. Right valve with an anterior pointed tooth; left valve with a stout posterior tooth, flattened and sulcated on its upper surface. Pallial sinus indistinct.

Dimensions.—Antero-posterior diameter, 21; umbo-ventral diameter, 16; sectional diameter of united valves, 10 millimetres.

Localities.—Tasmania: Table Cape (*R. M. Johnston!*).

Digitized by Google

South Australia: Oyster beds at Nor'-West Bend; very abundant in the calciferous sand-rock of the River Murray Cliffs, near Morgan; in a well-sinking at "Nine-Mile Camp," near Nor'-West Bend. Victoria: Upper and lower beds at Muddy Creek; Corio Bay; Schnapper Point.

From the living *C. sulcata*, Lamarck, to which it has been referred, our fossil species differs in being less inequilateral, more pointed posteriorly, less gibbous, &c. A nearer ally among existing species is *C. fortisulcata*, E. Smith, from which it differs particularly in its truncated posterior margin.

Corbula pixidata, *spec. nov.* **Plate xvii., figs. 12*a*—12*b*.**

Ovately rhomboidal, rather solid, inequilateral, subinequivalve, moderately convex; the posterior side is a little produced, obliquely truncated, and sharply carinated from the umbo to the post-ventral angle. The umbones are in the anterior third, rather inflated, depressed, and incurved. The left valve is a little smaller than, and included within, the suberect ventral and posterior margins of the right valve; both are equally convex.

Both valves have the same ornamentation, which consists of angular concentric ridges and radial striæ; the ridges are usually numerous, fine, and close together, but are sometimes thicker and fewer.

Dimensions of a large specimen.—Antero-posterior diameter, 10·5; umbo-ventral diameter, 6·5; sectional diameter through both valves, 5 millimetres.

Localities. — Common in the Turritella clays at Blanche Point, Aldinga, and corresponding beds in the Adelaide bore.

C. pixidata is much like the young of the last species, but it is less inequivalve, more convex, with larger umbones, and is proportionately shorter.

Neæra subrostrata, *spec. nov.* **Plate xv., figs. 2*a*—2*b*.**

Ovate, inequilateral, produced into a long beak behind, moderately convex, thin; front dorsal margin slightly convex and considerably sloping, the post-dorsal part somewhat longer, less oblique, and moderately concave; the ventral margin is irregularly arched, sinuated in front of the rostral prolongation. A distinct keel starts from behind the umbo, is directed towards but does not extend so far as the lower corner of the rostrum.

The ornament consists of coarse concentric lines of growth, becoming lamellose at the umbo and rostral insinuation.

Right valve with an elongate lateral tooth on the posterior side; left valve edentulous; cartilage-plate well developed, obliquely inclined backward.

Digitized by Google

Dimensions.—Antero-posterior diameter, 18; umbo-ventral diameter, 9; sectional diameter of one valve, 3·5 millimetres.

Locality.—Lower beds at Muddy Creek.

This species is similar to *N. rostrata*, Spengler, and *N. Angasi*, E. A. Smith, but it has a shorter anterior side.

Young? fig. 2*b*, which seems indistinguishable from *N. inflata*, Jeffreys, P.Z.S., 1881, t. 71, f. 8, has the following dimensions:—Antero-posterior diameter, 6·5; umbo-ventral diameter, 4·5 millimetres.

Neæra Adelaidensis, *spec. nov.* **Plate xix., fig. 8.**

Ovate, rather depressed, inequilateral, anterior end rounded, posteriorly produced into a longish slender beak; the beak is obliquely bisected by a sharp radiating ridge.

The surface is ornamented by few, regular, distant, short, and thin lamellæ. Interior unknown.

Dimensions.—Antero-posterior diameter, 5; umbo-ventral diameter, 3; sectional diameter of closed valves, 1·5 millimetres.

Locality.—Adelaide bore.

Neæra (Rhinomya) latesulcata, *spec. nov.* **Plate xix., fig. 7.**

Broadly-triangular, inequilateral, thin, flat, rounded anteriorly, produced and subrostrated posteriorly; ventral margin very slightly arched medially, inconspicuously insinuated posteriorly, somewhat rapidly ascending anteriorly; post-dorsal margin straight, much longer than the slightly arched front-dorsal margin; the posterior margin is very narrow, straight, and forming an obtuse angle with the ventral margin. The umbonal region is finely concentrically striated, and surmounted by a smooth umbonal papilla; the rest of the surface ornamented with six acute concentric folds, raised into thin, short, erect lamellæ; the broad interspaces finely concentrically striated. The post-dorsal area is defined by a raised line proceeding from the post-ventral angle towards the umbo as far as the smooth umbonal area. The right valve has a short anterior tooth, and an elongate lamellar tooth posteriorly for about one-third the distance from the umbo, beyond which it is continued as a shelf-like process to the extremity of the post-dorsal margin. There is no cartilage-process.

Dimensions.—Antero-posterior diameter, 4; umbo-ventral diameter, 2·5 millimetres.

Locality.—Adelaide bore.

FAMILY SAXICAVIDÆ.

Saxicava arctica, *Linn.*

Synonym.—*Saxicava australis* (Lamk.), Tate in Trans. Roy. Soc., S. Aust., for 1885, pl. xii., fig. 8.

Digitized by Google

A few specimens of Saxicava obtained from the basal beds of the marine series of the Older Tertiary, passed through in the Adelaide bore, fall within the limits of variation of the above-named protean shell of world-wide distribution. Also ranging from Miocene to Recent, in New Zealand.

Panopæa Agnewi, *T. Woods.*

Reference.—*Lyonsia Agnewi*, Tenison-Woods, Roy. Soc., Tasm., for 1875, f. 13, p. 25.

Transversely-ovate, inequilateral, somewhat solid, convex, concentrically ridged and striated, posteriorly attenuately rounded, anteriorly obliquely produced, and broader; gaping at both ends. Test minutely granulated in the umbonal regions, intricately radially striated on the posterior side towards the margin.

Dimensions of the type specimen.—Antero-posterior diameter, 77; umbo-ventral diameter, 44; length of anterior side, 27; length of posterior side, 50; sectional diameter through both valves, 32 millimetres.

Locality.—Table Cape (*Hobart Mus.!* and *R. M. Johnston!*)

Panopæa orbita, *Hutton.* Plate xviii., fig. 3.

Reference—Quart. Journ. Geol. Soc., vol. 41, p. 451, 1885.

Synonym.—*P. plicata*, Hutton, Cat. Foss., N. Zealand, p. 17, 1873 (non Sowerby).

The specific identity of the Australian and New Zealand specimens associated under the above name rests on the comparisons of actual examples. *P. orbita* is closely related to *P. Agnewi*, but the latter is more inflated, and of different dimensions.

Dimensions of the figured example. — Antero-posterior diameter, 85; umbo-ventral diameter, 37; length of anterior side, 25; length of posterior side, 60; sectional diameter through both valves, 26 millimetres.

Localities.—Oyster beds at Aldinga and Adelaide (casts), Middle Murravian series near Morgan, and the correlated beds at Muddy Creek. Also in the Pareora Series, New Zealand.

Capistrocardia, *nov. gen.*

Etymology—*Capistrum*, a halter, and *cardo*, a hinge. Type—*C. fragilis*, spec. nov.

Shell transverse, equivalve, inequilateral, closed at both ends; ligament external; a cardinal tooth in each valve, and an umbonal rib extending across the interior; pallial sinus entire, discontinuous.

The hinge line is very short and narrow. The right valve has a broadish erect tooth contiguous with the umbo, posterior to which is a shallow pit, bounded above by a linear ridge,

Digitized by Google

which supported the external ligament; in the left valve the cardinal tooth is obliquely transverse, and the posterior pit is broad; there is a short ligamental ridge, as in the right valve. The umbonal rib, which is confluent with the cardinal tooth, is short, and extends vertically across the interior to near the ventral margin. The anterior adductor impression is almost margined in front of the umbonal rib; the posterior adductor impression is a little nearer the posterior end than to the umbo. The pallial line is broken up into large spots, and there is no sinus (at least none is observable in the two examples, in which the pallial spots are clearly traceable).

This genus has an external resemblance to Saxicava, whilst its dentition agrees with Panopæa; from both of which it differs by its closed valves and internal septa. The discontinuous pallial line is a character belonging to Saxicava, and to some species of Panopæa, but in both those genera it is sinuated.

Capistrocardia fragilis, *spec. nov.* **Plate xix., figs. 14*a*—14*b*.**

Shell small, thin, translucent, transversely elongate-oblong. Umbones depressed, approximate, near to the anterior margin. Anterior margin rounded; dorsal margin sloping backwards, forming an obtuse angle with the posterior margin, which is straight or slightly convex outwardly; ventral margin straight, save for a broadish post-medial inflexion. The umbonal ridge, extending to the post-ventral margin, is moderately raised and roundly angulate.

The exterior surface of the valves is smooth and concentrically distantly striate; a few lamellæ appear towards the margins.

Dimensions.—Antero-posterior diameter, 11·5; umbo-ventral diameter, 5 millimetres.

Locality.—Gastropod bed of the middle Murravian, near Morgan. Ten examples (*R.T.*).

FAMILY SOLENIDÆ.

Solen sordidus, *spec. nov.* **Plate xix., fig. 2.**

This species is so very like *S. Sloanii*, inhabiting the coast of New South Wales, that a detailed description is unnecessary. It differs by its straighter dorsal line and being a little narrower; in *S. Sloanii* the length is five and a-half times the width; in *S. sordidus* it is six times. The actual dimensions are—Length, 42·5; breadth, 7 millimetres.

Locality.—Muddy Creek.

The species has the dentition of *Solen* and not of *Ensis*.

Digitized by Google

Genus Solecurtus.

SYNOPSIS OF THE SPECIES.

Roundly truncated anteriorly.
- Posterior side broader; grooves on the umbonal slope angularly turned back. *S. Legrandi.*
- Posterior side narrower, grooves hardly curved on the umbonal slope. *S. Dennanti.*

Acutely rounded anteriorly, grooves roundly curved on the umbonal slope. *S. ellipticus.*

Solecurtus Legrandi, *spec. nov.* **Plate xvii., fig. 15.**

Transversely-oblong, thickish, gaping at both ends, slightly convex, but medially and antero-dorsally depressed; inequilateral, the posterior side about three-fifths the whole length, anterior side narrower than the posterior. Front-dorsal line straight, perceptibly sloping, and slightly incurved, post-dorsal margin rather abruptly ecurved; ventral margin horizontal, curving upwards more abruptly at the front than behind; anterior margin roundly truncated. Umbones small, approximate, recurved, hardly projecting beyond the dorsal margin.

Surface shining, white, blotched with brown about the middle and posterior regions; ornamented with distant linear concentric grooves and striæ; radially finely striated on the anterior slope. The sculpture consists of engraved lines *en chevron*, radiating from the umbo to the posterior and ventral margins, not extending on to the area limited by a line drawn from the umbo to front ventral angle; the anterior limb of each sculpture line is arched—the convexity towards the front dorsal side, and its continuity interrupted by the concentric grooves; the posterior limb is straight, with a wavy outline.

Dimensions.—Antero-posterior diameter, 40; umbo-ventral diameter, 17·5; sectional diameter, 10 millimetres.

Locality.—Table Cape (*Hobart Mus. !*).

By the courtesy of the Council of the Royal Society of Tasmania, I have had under examination the unique type of *Solecurtus Legrandi*, T. Woods, Proc. Roy. Soc., Tasm., for 1875, p. 25, pl. 3, f. 14; but as the figure incorrectly represents the shell with abruptly truncated extremities, which is otherwise imperfect, and the diagnosis accords therewith, I have deemed it advisable to refigure and redescribe the fossil. As it would lead to confusion to retain the Rev. J. E. Tenison-Woods' authority for the species, it appears here under the original name as a new species.

Solecurtus Dennanti, *spec. nov.* **Plate xvi., fig. 17.**

Transversely-oblong, moderately thick, gaping at both ends; posterior side about two-thirds the whole length; moderately

Digitized by Google

convex, medially depressed. Anterior and posterior extremities about equally rounded; ventral and dorsal margins nearly parallel; front dorsal margin a little incurved; post-dorsal margin nearly straight, gently sloping, perceptibly attenuated towards the extremity. Umbo small, acute, recurved.

Pallial sinus broad, truncately rounded at the end, almost reaching to the anterior adductor scar.

Surface shining; sculpture consisting of concentric growth-lines and fine striæ, radial striæ on the anterior and posterior slopes, and of oblique distant engraved lines posterior to a line joining the umbo and the antero-ventral margin. The oblique lines of sculpture are nearly straight on the medial portion of the valve, crossing on to the post-dorsal slope in a gentle curve.

Dimensions—Antero-posterior diameter, 29·5; umbo-ventral diameter, 12·5 millimetres.

Locality.—Lower beds at Muddy Creek (*J. Dennant*!)

Solecurtus Dennanti differs from the foregoing species in being more rounded anteriorly, more attenuated posteriorly, less inequilateral, narrower, and in the fewer and simpler oblique lines of sculpture.

Solecurtus ellipticus, *spec. nov.* **Plate xvi., fig. 14.**

Transversely ovate-oblong, thin, translucent, inequilateral, posterior side about five-eights of the whole length; somewhat attenuated at both ends, obliquely rounded in front, broadly rounded behind; the dorsal margins straight, the front part sloping more rapidly than the other.

The oblique lines of sculpture are distant, a little curved on the medial portion of the valve, roundly turned back as they cross on the dorsal slope.

Dimensions.—Antero-posterior diameter, 16; umbo-ventral diameter, 8 millimetres.

Locality.—Gastropod-bed in the River Murray Cliffs, near Morgan.

This species differs from the two former by its sloping dorsal margins; in the arrangement of its sculpture-lines it approximates to *S. Dennanti*, of which it may possibly be a young example. Compared with *S. candidus*, it is distinguished by its sloping dorsal margins, and therefore more attenuated extremities; the umbonal ridge is obsolete, and consequently the sculpture-lines are curvilinear and not angulated, they are, moreover, wider apart.

FAMILY PHOLADIDÆ.

Barnea tiara, *spec. nov.* **Plate xviii., figs. 1*a*—1*c*.**

Narrowly-elongate, inequilateral, the umbo situated at three-sevenths of the whole length from the front, attenuated at both

Digitized by Google

ends, acutely rounded in front, bluntly rounded behind. The post-dorsal area is very precipitous and concave behind the umbo. The surface is ornamented with concentric liræ, which are angular on the medial and anterior areas, and there crossed by radiating threads, which are subspinose at the intersections, the insterstitial spaces are concentrically striated; on the posterior half of the valve the concentric liræ are rounded, sharply bent forward on crossing the umbonal ridge, and the surface is granulated.

The single *dorsal plate* is narrowly oblong, rounded at the front, the very short posterior side is bent down at right angles, roundly truncated and medially insinuated at the end. The anterior portion of the plate has a wide, shallow median depression, bounded by an obtuse ridge on each radiating from the umbo, the whole crossed by closely-set sharply-arched lamellæ; the narrow lanceolate depressed marginal areas exterior to the umbonal ridges are granulated.

Dimensions.—Antero-posterior diameter, 42; umbo-ventral diameter, 12; sectional diameter of one valve, 6 millimetres.

Locality.—Upper beds at Muddy Creek.

Jouannetia cuneata, *spec. nov.* Plate xvii., fig. 2.

Subglobose, inequilateral; posterior side somewhat depressed, cuneiform, its extremity bluntly rounded (not at all pointed); the anterior side is inflated, and its extremity is rounded. The shell is inequivalve by reason of the callous development from the one valve overlapping the anterior portion of the other.

An angular depression radiates from the middle of the umbo with a slight posterior inclination to the ventral margin.

The whole surface of the valve is ornamented with thin, distant concentric lamellæ, striated in the interspaces, and distant radial threads on the umbonal area of the anterior side, and a few riblets towards the anterior margin and on the post-umbonal ridge.

Dimensions.—Antero-posterior diameter, 24; umbo-ventral diameter, 17; sectional diameter of both valves, 16 millimetres.

Locality.—Glauconitic sand bed in the Adelaide bore.

The species is distinguished by its blunt posterior extremity and the fewness of the lamellæ of growth.

FAMILY TEREDINIDÆ.

Teredo (Kuphus) Heaphyi, *Zittel.*

Reference.—*Teredo Heaphyi*, Zittel, Pal. von Neu-Seeland, p. 45. tab. 14, fig. 4.

Digitized by Google

Synonym—Cladopoda directa, Hutton, Trans. N.Z. Inst., 1877, p. 597, t. 16, f. 13.

Tube elongate, round, irregularly contorted; constricted at intervals at the proximal end, more regularly distally; concamerated and closed by an outwardly convex plate.

It would seem to have attained to gigantic dimensions, as one fragment of a length of 160 millimetres has a diameter at the ends of 8 and 10 millimetres; other fragments measure 17 millimetres in diameter.

Localities.—Calciferous sand rock of the River Murray Cliffs at McBean's Pound, near Blanchetown; in the raggy limestones at Mannum; in the limestone with glauconitic grains, Aldinga Cliffs.

Teredo, *sp.*

Casts of short clavate tubes, about 15 millimetres long by three in diameter, in fossil wood at Gawler, indicate a species with a totally different habitat from the above.

Teredo, *sp.* Plate xix., fig. 4.

A single valve from the lower beds at Muddy Creek.

FAMILY GASTROCHÆNIDÆ.

Aspergillum (Humphreyia) liratum, *spec. nov.* Plate xix., fig. 11.

Disk roundly oblong, adherent by one valve. Tube cylindrical, a little irregular, slightly angulated on the dorsal and ventral sides; ornamented with longitudinal distant threads (about 20) and irregular folds of growth and striæ.

Dimensions.—Total length, 16; diameter of tube, 5 millimetres.

Localities.—A perfect example, Adelaide bore; fragments in the calciferous sandstone near Morgan, and correlated beds at Muddy Creek.

More nearly related to *A. multangulare*, Tate, than to the other two living species, but is distinguished by the numerous longitudinal threads on the tube.

One or two other species of Aspergillum are indicated by casts obtained from the glauconitic limestone at Aldinga, and corresponding bed at Witton Bluff.

APPENDIX.

Ostrea manubriata, *spec nov.* Plate xix., fig. 10.

Shell rather thick, varying from narrow oblong to elongate-acuminate. Upper valve flat or sub-concave, with thin, distant, adpressed lamellæ of growth. Attached valve narrowly compressed, abruptly convex, concentrically flexuosely ridged and

Digitized by Google

striated; hinge usually very elongate, broadly excavated in the middle.

Locality.—Common in ths upper beds at Muddy Creek (*J. Dennant !*)

This new species has considerable affinities with *O. undata* Lamk., of the Tertiary beds of Europe, but has a narrower and deeper lower valve, which is devoid of radial plications; it is also something like the recent *O. Virginica* of the same author. It is very different from any known species inhabiting the Australian seas.

Pecten deformis, *spec. nov.* Plate xviii., fig. 4.

Triangularly ovate, compressed, obliquely extended posteriorly and inequilateral; in the young state regular, subequilateral.

The young regular stage of growth is seen for about 30 millimetres from the umbo; is ornamented with about 50 radial subacute narrow ribs, usually grouped in threes, the middle one being the larger, and with quincuncially arranged depressions between the ribs.

The older stage of growth is marked by the sudden irregularity of general growth and change of ornament—the radial ridges becoming almost obsolete, and strong growth folds and concentric striæ developed.

The ears are unequal, the proximal portions radially ribbed and shagreen sculptured, the distal portions irregular and inornate.

Dimensions.—Umbo-ventral and antero-posterior diameters, 47 millimetres.

Locality.—Upper beds at Muddy Creek.

This species, which is related to *P. consobrinus*, Tate, may prove to belong to *Hinnites*, but at present the left valves only have been obtained.

Pecten subconvexus, *spec. nov.* Plate xviii., fig. 2.

Irregularly orbicular, moderately convex, produced in front, radially ribbed. Ribs about 27, broad, truncated, considerably elevated, becoming thinner and subacute towards the sides; an indistinct appearance of three radial plications is produced by thicker ribs occurring close together in pairs. The interspaces between the ribs are as wide or a little wider than the ribs; they are concentrically sulcate, the intervening elevated threads are about equal in width to the sulci. Ears? Margin of the valve crenately undulate.

Dimensions.—Antero-posterior diameter, 30·5; umbo-ventral diameter, 31·5; sectional diameter of right valve, 5·5 millimetres.

Locality.—Upper beds at Muddy Creek (*J. Dennant !*).

Digitized by Google

Amongst recent species *P. subconvexus* is most nearly related to *P. convexus*, Quoy and Gaimard, from which it differs by the absence of radial folds, and the fewer, more distant, and flatter ribs; it is, moreover, less inflated. In a lesser degree it resembles *P. polymorphoides*, Zittel, which occurs at a lower geological horizon.

Lithodomus brevis, *spec nov.*

Lithodomus, sp., Tate, Trans. Roy. Soc., S. Australia, for 1885, p. 124.

Cylindrical, short; umbones tumid, incurved, submarginal; somewhat attenuated posteriorly, convexedly truncated anteriorly; post-dorsal margin very slightly arched, posterior margin rounded; ventral margin perceptibly incurved antemedially, the sloping anterior end making with the ventral margin an obtusely-rounded angle.

Surface marked with a few concentric ridges.

Dimensions.—Antero-posterior diameter, 21; greatest transverse diameter at the middle, 11; greatest sectional diameter through both valves at about half the total length, 11 millimetres.

Locality.—In crypts excavated in the coral *Plesiastræa Vincenti*, T. Woods, occurring at Hallett's Cove, St. Vincent Gulf.

This species is of about the same dimensions as *L. n. sp.* from Port Darwin, but the outline is not so curvated and the umbones do not project, or hardly at all, beyond the anterior margin.

Mytilus Hamiltonensis, *spec. nov.* Plate xviii., fig. 9.

Oblong-subtrigonal, angled, uncinate. Ornamented with very numerous frequently bifurcating radial threads, which are inconspicuously elevated, somewhat flatly rounded, separated by narrower interspaces; crossed by slender and close-set lines of growth.

Inner margin of valves denticulated all round. There are two or three small teeth under the umbo in the right valve. The anterior adductor scar is raised on a prominent boss, almost within the umbonal cavity. The byssal insinuation is of moderate size.

Dimensions of a moderate-sized example:—Umbo-ventral diameter, 47; length of hinge, 23; sectional diameter, 19; length of posterior margin, 33 millimetres.

Locality.—Upper beds at Muddy Creek (*R.T.* and *J. Dennant!*).

This fossil has the general appearance of the living *M. hirsutus*, Lamk., though slightly different in outline, the anterior and posterior margins being nearly straight and parallel, whilst in *M. hirsutus* they are concave and convex respectively;

Digitized by Google

the area anterior to the umbonal ridge is not so precipitous, and the ridge is not so elevated as in the recent species. The radial threads are not so elevated, and are separated by narrower furrows; the concentric ornament is, moreover, finer. The anterior adductor boss is peculiar.

When describing *Septifer fenestratus* I had only one specimen of *Mytilus Hamiltonensis* before me, which I then regarded as an adult shell of that species; the observations published thereupon should be erased from the diagnosis of *Septifer fenestratus*. These refer to the filling up of the umbonal cavity and the dimensions of the shell.

Mytilus linguatulus, *spec. nov.* **Plate xix., fig. 3.**

Narrowly oval, rather compressed; umbones uncinate; anterior margin nearly straight, the dorsal and posterior margins forming an interrupted curve; anterior side very narrow, descending abruptly from the low umbonal ridge. The surface is ornamented with elevated rounded radial threads, rather narrower than the flat furrows, and strong folds of growth and fine concentric wrinkles. The margin of the valves is crenulated all round. There is an elongated tooth under the hinge; and the anterior adductor is raised on a prominent boss. The byssal insinuation is inconspicuous.

Dimensions.—Umbo-ventral diameter, 48; greatest transverse diameter at right angles, 19; sectional diameter, 16 millimetres.

Locality.—Upper beds at Muddy Creek (*J. Dennant!*)

This species is very like *M. rostratus*, Dunker, but wants the angulation of the dorsal margin; the beaks are more produced, slightly excavated, not swollen, beneath and in front of the umbo; it has one long tooth in place of two or three short ones, and the anterior adductor boss is peculiar.

Mytilus deperditus, *spec. nov.* **Plate xix., fig. 1.**

Oblong; test thick, especially about the umbo, which is obtuse and swollen. Surface ornamented with strong folds and striæ of growth. Margin of valve plain; hinge with one large tooth.

Dimensions. — Umbo-ventral diameter, 80; transverse diameter towards the extremity of the hinge line, 35; sectional diameter of one valve, 16; length of hinge line, 60 millimetres.

Locality.—Upper beds at Muddy Creek (*J. Dennant!*)

M. deperditus resembles *M. latus*, Chemnitz (non Lamarck), but presents the following differential characters:—Narrower, the anterior side steeper, straighter, and longer hinge lines, stronger growth-folds, and convex, not concave, under the umbo.

Digitized by Google

Leda vagans, *spec. nov.*

Synonym.—*L. lucida*, Tenison-Woods; see Part I. (non Loven, id. Jeffreys, Brit. Conch.).

FAMILY ASTARTIDÆ.

Genus Carditella.

Micromeris rugosa, *M. radiata*, and *Gouldia lamellata*, described in Part I., prove to be congeneric, and may find a place in Mr. E. A. Smith's genus *Carditella*, rather than in *Micromeris* of Conrad.

The dentition is as follows:—

The *right valve* has one triangular subcentral tooth; a longitudinal posterior tooth separated from the margin by a deep furrow. The *left valve* has two divergent cardinal teeth, and a longitudinal anterior tooth separated from the margin by a shallow furrow.

The acute posterior edge of the left valve is received in the furrow of the right valve, and the acute anterior edge of the right valve fits into the furrow of the left valve; in consequence of this the right valve overlaps the left valve on the posterior hinge line, and the left overlaps the right on the anterior hinge line.

In *C. radiata* the lateral teeth and furrows are transversely striated, and there is sometimes developed a small supplementary laminate cardinal tooth in either valve.

Two new species are here added.

SYNOPSIS OF THE SPECIES.

Shell trigonal.
- Ornament of fimbriated imbricating lamellæ. *C. rugosa.*
- Ornament of radial ridges and simple folds. *C. radiata.*
- Surface smooth, slightly inequilateral. *C. polita.*

Shell subquadrangular.
- Ornament of 20 thin lamellæ. *C. lamellata.*
- Densely lamellated. *C. multilamella.*

Carditella polita, *spec. nov.* Plate xx., figs 20 and 21.

Shell trigonal, compressed with produced rather straight umbones; the young shells are equilateral, but in the adult the anterior side is slightly produced. The surface is polished, indistinctly marked with concentric lines. The inner margin of the valves is finely crenulated all round. The cardinal tooth in the right valve is stout and sulcated on the crown as in *C. radiata*.

Dimensions.—Antero-posterior and umbo-ventral diameters, 2·5 millimetres.

Locality.—Lower and upper beds at Muddy Creek; gastropod bed, River Murray Cliffs near Morgan.

Digitized by Google

Carditella multilamella, *spec. nov.* **Plate xx., fig. 17.**

This species is similar to *C. lamellata*, but it differs by its ovately-oblong form, and the stoutish recurved, numerous lamellæ. It might be overlooked for the fry of *Chione Cainozoica*.

Dimensions.—Antero-posterior diameter, 3; umbo-ventral diameter, 2·5; sectional diameter of one valve, ·75 millimetres.

Locality.—Lower beds at Muddy Creek.

Cardita solida, *spec. nov.* **Plate xx., fig. 18.**

Subtrigonally cordate, very thick, moderately convex, subequilateral, both ends obtusely rounded. The dorsal margin is considerably oblique on both sides of the prominent umbo, which is well curved over towards the front; the lunule is depressed, cordiform; the ventral margin is much curved. It is ornamented with eighteen radial ribs, which are stout, rounded, and almost smooth; the interspaces are a little broader than the ribs, transversely stoutly lirate. Margin strongly plicated.

Dimensions.—Antero-posterior diameter, 6·5; umbo-ventral diameter, 6·5; sectional diameter of one valve, 2·5 millimetres.

Locality.—Upper beds at Muddy Creek (*J. Dennant!*).

This new species has some affinity with the Tasmanian *C. Gunnii*, Desh., and *C. bimaculata*, Desh., but the shape is different, in which particular, however, it agrees with *C. Beddomei*, E. A. Smith, differing from it by the fewer non-nodulose ribs.

Cardita calva, *spec. nov.* **Plate xx., fig. 14.**

Ovately-subtrigonal, subequilateral, moderately depressed; rounded anteriorly, truncatedly rounded posteriorly. Umbones prominent, acute, slightly incurved; lunule depressed, broadly lanceolate, smooth, with well-defined margins.

The umbonal area is smooth, with excentric distant sulcations, the rest of the surface of the valve radiately ribbed; ribs 20, covered with thick closely-set granulations; the interspaces on the medial part of the surface are linear or almost obliterated, becoming wider towards the anterior and posterior margins.

Dimensions.—Antero-posterior diameter, 5·25; umbo-ventral diameter, 5· ; sectional diameter of one valve, 1·5 millimetres.

Localities.—Older beds, Muddy Creek; well-sinking on Cooke's Plains, east of Lake Alexandrina.

The nearest ally to this species is *C. compacta*, Tate, but is slightly different in shape, and depressed, the gross ornament and smooth umbo especially distinguish it.

Digitized by Google

The Scaphopods of the Older Tertiary of Australia.

By Professor Ralph Tate, F.G.S., F.L.S.

[Read October 5, 1886.]

Genus Entalis.

synopsis of the species.

Longitudinally ribbed and transversely striated.
E. Mantelli.

Surface smooth or transversely striated.
Dorsal slit short, triangular. *E. subfissura.*
Dorsal slit linear, long.
Shell curved, slender, smooth. *E. acriculum.*
Shell straight, with annular ridges. *E. annulatum.*

Entalis Mantelli, *Zittel.*

Dentalium sp., Mantell, Quart. Journ. Geol. Soc., vol. vi., p. 331, t. 28, f. 15.

Dentalium Mantelli, Zittel, Palæontologie von Neu Seeland, p. 45, t. 13, fig. 7, 1865; id., Hutton, Tertiary Fossils of N.Z., p. 4, 1873.

Dentalium tenuis and *D. irregularis*, Hutton, op. cit.

Shell from nearly straight to subarcuate, thick, round, gradually tapering. Ornamented with a variable number of longitudinal ribs (from about 20 to 50), which are angular posteriorly, but become more numerous and usually rounded as they approach the base, where they are almost obsolete; the ribs are for the most part of equal dimensions, but occasionally they are alternately slightly broad and narrow; the interspaces are much narrower than the ribs, sometimes almost linear. The whole surface crossed by annular threads and slight grooves, coincident with the aperture, which produce slight crenulations on the longitudinal ribs. Aperture circular, with a thin edge. Fissure very long and narrow.

Dimensions of a moderately large example:—Length, 50; diameter of aperture, 5; length of fissure, 5 millimetres; but attaining to a length of 70, with a breadth of aperture of 7 millimetres.

Localities.—Very abundant at most of the localities—Gastropod bed of the River Murray Cliffs near Morgan, in a well-sinking at Nine-mile Camp, near Nor'-West Bend; lower beds at Muddy Creek; in the calciferous sandstone at Corio Bay; in the blue clays at Schnapper Point, Port Phillip; in the Turritella clays at Blanche Point, Aldinga Bay; and in the glauconitic clayey sands in the Adelaide bore; Table Cape (*Tenison-*

Digitized by Google

Woods). Also in the Oamaru and Pareora Series, New Zealand.

This common species in the Older Tertiary strata of Australia has been identified with *D. Mantelli*, equally common in New Zealand, after a comparison of authentic specimens. Prof. Hutton has merged his *D. irregularis* with that species, and I cannot find any distinctive characters for his *D. tenuis*, specimens of which I have had under examination. However, none of the New Zealand specimens which I have seen have the apex preserved, and no mention is made by either Zittel or Hutton of the presence or absence of an apical slit.

The ornament of the test of *D. Mantelli* is so exceedingly variable in respect to the number, size, and shape of the longitudinal ribs that it becomes difficult to select diagnostic characters. In two examples of equal length taken at random the number of ribs at the base of the slit is 17 and 20, increasing at the anterior end to 26 and 50 respectively. Examples from Aldinga have much finer transverse threads.

D. giganteum, Sowerby (in Darwin's Geol. Obs. on S. America), of which *D. solidum*, Hutton, is a synonym, is distinct, though conspecific with *D. Mantelli*.

The Rev. J. E. Tenison-Woods gave the name of *D. Kicksii*, Nyst, to a Table Cape fossil, and from his description of it there cannot be a doubt of its identity with *D. Mantelli*, Zittel. The very brief diagnosis of the Belgian fossil does not permit an identification.

Entalis subfissura, *spec. nov.* **Plate xx., figs. 4*a*.—4*b*.**

Shell thin, subulate, moderately curved, slightly compressed dorso-ventrally, smooth, polished; faintly marked with annular striæ (visible under a lens) and growth ridges. Apical fissure a shallow triangular notch, the embryonal projecting tube prominent.

Dimensions.—Length, 46; dorso-ventral and transverse diameters of aperture, 4 and 4·25 millimetres respectively.

This species has the general aspect of *Entalis fissura*, Lamk., of the Paris Basin, but the apical fissure is linear and not triangular. It may be conspecific with *D. lævis*, Hutton, but that species is too incompletely known to permit of satisfactory identification.

Localities.—Gastropod bed of the River Murray Cliffs near Morgan, and well-sinking at Nine-mile Camp, near Nor'-West Bend; Muddy Creek, Corio Bay, and Schnapper Point, Victoria; Turritella clays at Blanche Point, Aldinga Bay.

Entalis annulatum, *spec. nov.* **Plate xx., figs. 6*a*—6*b*.**

Shell nearly straight; test thick, smooth, polished; orna-

Digitized by Google

mented with close set, depressed, annular ridges, barely visible by the unaided eye.

Dimensions.—Length, 74; diameter of anterior aperture, 6·5 millimetres.

Locality.—Muddy Creek.

Entalis acriculum, *spec. nov.* **Plate xx., fig. 11.**

Shell thin, subulate, very slightly curved, smooth, polished; marked with annular striæ (visible under a lens); oral aperture circular; posterior aperture with a longish, linear fissure.

Dimensions.—Length, 33; diameter of anterior aperture, 2·5 millimetres.

Locality.—Lower beds at Muddy Creek.

Genus Dentalium.

SYNOPSIS OF THE SPECIES.

Longitudinally six to eight sulcated. *D. aratum.*
Longitudinally ribbed posteriorly, smooth anteriorly. *D. (?) bifrons.*
Without longitudinal ornament; round, stout. *D. lacteum.*
Trigonal, slender. *D. (?) triquetrum.*

Dentalium aratum, *spec. nov.* **Plate xx., fig. 8.**

Shell small, slightly curved; acutely regularly 6 to 8 angled (usually 8); interspaces concave with a few slender longitudinal riblets and striæ, and close-set, fine, transverse striations.

The ornament varies in the acuteness and strength of the ribs, and therefore in the depth of the interspaces; in some specimens, by reduction in volume of the primary ribs and the increased size of the intermediate ones, the anterior part is subrotund and multicostated.

Dimensions.—Length, 20; diameter of anterior aperture, 2 millimetres.

Localities.—Gastropod bed of the River Murray Cliffs near Morgan; lower beds at Muddy Creek; blue clays at Schnapper Point; Muloowurtie yellow clays near Ardrossan.

D. nanum, Hutton, is similar to this species, but its ribs vary from 8 to 13, and the interspaces are smooth.

Dentalium (?) bifrons, *spec. nov.* **Plate xx., fig. 5.**

Shell thin, round, nearly straight, posteriorly longitudinally ribbed, anteriorly smooth.

The ribs are slightly elevated, subangular, about 40 in number, sometimes they are alternately stout and slender, becoming more depressed, and finally disappearing at about one-third the total length from the apex; the anterior portion is

Digitized by Google

ornamented with very fine annular striæ, and a few ridges of growth.

Apex unknown.

Dimensions of the longest example.—Length, 92 (estimated at 100); diameter of anterior aperture, 9 millimetres.

Locality.—Upper beds at Muddy Creek.

The costated portion differs from *E. Mantelli* in not having the tessellated ornament; it is similar to *E. brevifissum*, Deshayes, of the Paris basin, but the ribs are only about 15, and to *E. substriatum* of the same author, but the apical part of that shell is finely striated.

Dentalium (?) triquetrum, *spec. nov.* Plate xx., fig. 3.

Shell very attenuated, rather thick, very slightly curved; extremely flattened laterally, so that the transverse section is an isosceles triangle, the angle on the convex side more rounded than those formed by the flattish concave face and the sides; the perpendicular from the convex side is a little longer than the base.

The surface is polished, ornamented by a few wavy undulations and microscopic striæ.

Dimensions.—Longer diameter of aperture at each end in a length of 10 millimetres, ·75 and ·5 millimetres respectively.

Locality.—Glauconitic sands, Adelaide bore.

Dentalium lacteum, *Deshayes.*

Reference.—Mon. Gen. Dentale, 1825, t. 16, f. 28.

The Rev. J. E. Tenison-Woods (Proc. Roy. Soc., Tasm., for 1875, p. 17) identified a Table Cape fossil with the above-named species living in the Indian Seas. I have not seen a specimen from the Tasmanian locality, but a common shell in the Muddy Creek beds agrees well with the figure, measurements, and description given by Deshayes. The original diagnosis is as follows:—Round, not slit at the posterior extremity, slightly arched, very smooth, very shining, subtranslucent; length, 30; diameter at aperture, 2·5 millimetres.

Cadulus mucronatus, *spec. nov.* Plate xx., fig. 10.*

Long, narrow, slightly bent; slightly swollen at a little nearer the anterior than the posterior end, more conspicuously so on the convex curve, which is a little nearer to the posterior end than is the bulging on the concave curve. Anterior to the inflation the tube is slightly laterally compressed. The mouth is slightly oblique, oval, with a thin and sharp edge; the posterior opening is round, thickened within, and bevelled to a sharp edge, inconspicuously mucronately produced on the con-

*A very imperfect representation of the shell.

Digitized by Google

vex side corresponding with a faint internal rib, and slightly insinuated laterally. Surface smooth, polished, microscopically concentrically and with faint indications of opaque transverse bands.

Dimensions.—Length, 7; diameter at swelling, 1·25; of mouth, ·9 millimetres.

Locality.—Not uncommon in the lower beds at Muddy Creek.

The outline of the shell is like that of *C. gracilis*, Jeffreys, but the shell is very much larger, and is otherwise very different.

Cadulus acuminatus.

Slightly curved, tapering at both ends, enlarging more rapidly posteriorly than anteriorly, but not at all bulging; surface smooth and shining; microscopically concentrically striated. Mouth circular, slightly oblique, thin; posterior opening circular, small, the edge thick,

Dimensions.—Length, 6; diameter at the middle, 1; of mouth, ·75 millimetres.

Locality.—Oyster beds of the Upper Aldinga series.

The species is not uncommon in shell sand on the shores of St. Vincent Gulf.

The Pteropods of the Older Tertiary of Australia.

By Professor Ralph Tate, F.G.S., F.L.S., &c.

[Read October 5, 1886.]

Genus Styliola.

SYNOPSIS OF THE SPECIES.

Without conspicuous ornament.	
Sides rounded; a dorsal furrow.	*S. Rangiana.*
Sides angulated; no dorsal furrow.	*S. bicarinata.*
Transversely annulated.	*S. annulata.*

Styliola Rangiana, *spec. nov.* Plate xx., fig. 2.

Shell slender, conical, pellucid; straightish, but slightly curved apically, and rather abruptly tapering to a fine point; in front of the apex are one or two small inflations; slightly compressed dorso-ventrally; ornamented with obliquely transverse striæ. A longitudinal sulcus extends from the aperture

Digitized by Google

on its dorsal side only, inclining to the left of the middle line to near the apex. Aperture oblique, ovate-rotund.

Dimensions.—Axial length, 5·5; major diameter of aperture, 1·25 millimetres.

Localities.—Muddy Creek and Schnapper Point, Victoria.

Compared with actual specimens of *Cleodora subulata*, Quoy and Gaimard, this species is distinguished by its elliptical aperture, by its proportionately greater breadth, and by its abruptly tapering apex.

Styliola bicarinata, *spec. nov.* Plate xx., fig. 9.

Shell slender, conical, pointed, straight; aperture transversely ovate; lateral margins strongly keeled.

Dimensions.—Axial length, 6·25; major diameter of aperture, 2 millimetres.

Locality.—Muddy Creek.

Styliola annulata, *spec. nov.* Plate xx., fig. 1.

Shell conical, straight, transversely annulated, smooth; aperture circular.

Dimensions.—Axial length, 8; diameter of aperture, 2 millimetres.

Localities.—Glauconitic clayey sands, Adelaide bore; Turritella clays, Blanche Point, Aldinga Bay.

This species presents some resemblance to *Creseis striata*, Rang, but the shell is straight, not incurved apically, and the annulations are on a larger scale.

Vaginella eligmostoma, *spec. nov.* Plate xx., fig. 7.

Elongate-ventricose, smooth, shining, apex acute; the posterior half is subcompressed, angulated on the sides, thence narrowing to near the aperture, where the shell expands laterally, though here the lateral compression is most distinct.

The sculpture consists of very fine arched striæ descending to the lateral angulations.

The aperture is narrowly oval-oblong, with truncatedly rounded ends; each lip has a median curvature bounded on each side by a broad insinuation.

Dimensions.—Total length, 7; greatest transverse diameter, 1·75 millimetres.

Locality.—Very abundant in the lower beds at Muddy Creek.

This species would appear to be distinct from *V. depressa*, Basterot, of the Miocene Basin of Bordeaux and Dax, chiefly by its sinuated aperture. Rang and Souleyet represent the aperture of *V. depressa* as having simple margins meeting at an angle.

Digitized by Google

Spiralis tertiaria, *spec. nov.* Plate xx., figs. 12*a*—12*c*.

Shell sinistral, thin, shining, transparent; subglobosely depressed, umbilicated. The last whorl is convex, rapidly enlarging, regularly curved, except near the suture, where it is rapidly descending; spire sunken, with the apical whorls rising to the level of the last whorl. Umbilicus small. Peristome thin, simple, a little reflexed at the umbilicus. Surface sculptured with fine sigmoid lines.

Diameter, one millimetre.

Localities.—Lower beds at Muddy Creek and blue clays at Schnapper Point.

Explanation of Plates.

N.B.—The figures are of the natural sizes except when otherwise stated.

Plate XIV.

1. Cardium Victoriæ, *Tate*. Muddy Creek. *a*, Left valve; *b*, enlargement of surface near the ventral margin.
2. Cardium hemimeris, *Tate*. Adelaide. *a*, Right valve; *b*, enlargement of portion of anterior half (not correct), and *c*, of posterior half.
3. Cardium moniletectum, *Tate*. Adelaide. *a*, Left valve; *b*, enlargement of surface.
4. Verticordia rhomboidea, *Tate*. River Murray Cliffs. Enlarged.
5. Chama lamellifera, *Tenison-Woods*. Schnapper Point. *a*, Attached valve; *b*, free valve.
6. Montacuta sericea, *Tate*. Muddy Creek. Enlarged.
7. Chione propinqua, *T. Woods*. Muddy Creek.
8. Chione propinqua, *T. Woods*. Table Cape.
9. Dosinia Johnstoni, *Tate*. Muddy Creek.
10. Diplodonta subquadrata, *Tate*. Muddy Creek. *a*, Left valve, and *b*, dorsal aspect of the same.
11. Dosinia imparistriata, *Tate*. Adelaide.
12. Dosinia Johnstoni, *Tate*. Muddy Creek. *a*, Left valve of an adult shell, and *b*, dorsal aspect of the same.
13. Verticordia pectinata, *Tate*. Muddy Creek. Enlarged.
14. Cytherea paucirugata, *Tate*. Muddy Creek.
15. Venerupis paupertina, *Tate*. Muddy Creek. Slightly enlarged.
16. Cytherea tenuis, *Tate*. Adelaide.
17. Chione subroborata, *Tate*. Muddy Creek. *a*, Left valve; *b*, dorsal aspect of right valve.

Digitized by Google

18. Cytherea Murrayana, *Tate*. River Murray Cliffs.
19. Loripes simulans, *Tate*. Aldinga. Slightly enlarged.

Plate XV.

1. Chione hormophora, *Tate*. Table Cape. *a*, Left valve; and *b*, its dorsal aspect.
2. Neæra subrostrata, *Tate*. Muddy Creek. *a*, Adult shell; *b*, young (?) shell. Much enlarged.
3. Chione dimorphophylla, *Tate*. River Murray Cliffs. *a*, Left valve; *b*, dorsal aspect of united valves.
4. Meroe gibberula, *Tate*. Muddy Creek. *a*, Right valve, and *b*, dorsal aspect of the same.
5. Thracia perscabrosa, *Tate*. Muddy Creek.
6. Chione multilamellata, *Tate*. Adelaide. *a*, Left valve; and *b*, dorsal aspect of the same.

Plate XVI.

1. Chione Corioensis, *Tate*. Corio Bay. Enlarged.
2. Chione dictua, *Tate*. River Murray Cliffs. Slightly enlarged.
3. Chione Cainozoica, *T. Woods*. Schnapper Point. *a*, Right valve; *b*, its dorsal aspect.
4. Tellina albinelloides, *Tate*. Muddy Creek. *a* and *b*, Left and right valves.
5. Tellina æquilatera, *Tate*. Muddy Creek. *a*, Left valve; *b*, interior of right valve.
6. Tellina Masoni, *Tate*. Muddy Creek. *a*, Left valve; *b*, right valve; *c*, dorsal aspect of left valve.
7. Tellina Stirlingi, *Tate*. Muddy Creek. *a*, Left valve, and *b*, its dorsal aspect. Enlarged.
8. Tellina porrecta, *Tate*. Adelaide. Slightly enlarged.
9. Tellina equilatera, *Tate*. River Murray Cliffs. *a*, Left valve of a very young shell (ventral margin too much arched); *b*, dorsal aspect of the same. Enlarged.
10. Psammobia æqualis, *Tate*. Muddy Creek. Slightly enlarged.
11. Donax depressus, *Tate*. River Murray Cliffs.
12. Semele vesiculosa, *Tate*. Muddy Creek. Slightly enlarged.
13. Psammobia Hamiltonensis, *Tate*. Muddy Creek.
14. Solecurtus ellipticus, *Tate*. River Murray Cliffs. Slightly enlarged.
15. Donax Dixoni, *Tate*. Muddy Creek. Enlarged.
16. Myodora angustior, *Tate*. Muddy Creek. Slightly enlarged.
17. Solecurtus Dennanti, *Tate*. Muddy Creek.
18. Semele Krauseana, *Tate*. Schnapper Point. *a*, Right valve; *b*, dorsal aspect of closed valves.

Digitized by Google

Plate XVII.

1. Mactra axiniformis, *Tate*. Muddy Creek. *a*, Right valve *b*, dorsal aspect of the same.
2. Jouannetia cuneata, *Tate*. Adelaide.
3. Mactra Howchiniana, *Tate*. Muddy Creek. *a*, Right valve; *b*, dorsal aspect of the same.
4. Mactra Hamiltonensis, *Tate*. Muddy Creek. *a*, Right valve; *b*, its dorsal aspect.
5. Anapa variabilis, *Tate*. Aldinga. *a*, Right valve; *b*, its dorsal aspect.
6. Myodora lamellata, *Tate*. Adelaide. *a*, Right valve; *b*, left valve; *c*, dorsal aspect of united valves. Enlarged.
7. Myodora lamellata, *Tate;* var. Adelaide. Right valve. Enlarged.
8. Myodora æquilatera, *Johnston*. Table Cape. Left valve.
9. Myodora tenuilirata, *Tate*. Muddy Creek. *a* and *b*, Right and left valves.
10. Myodora australis, *Johnston*. Table Cape. *a* and *b*, Right and left valves.
11. Myodora corrugata, *Tate*. Muddy Creek. *a* and *b*, Right and left valves.
12. Corbula pixidata, *Tate*. Aldinga. *a*, Left valve; *b*, dorsal aspect of united valves. Slightly enlarged.
13. Corbula ephamilla, *Tate*. River Murray Cliffs. *a*, Left valve; *b*, right valve; *c*, dorsal aspect of united valves.
14. Corbula ephamilla, *Tate*. Young shell, much enlarged.
15. Solecurtus Legrandi, *Tate*. Table Cape.

Plate XVIII.

1. Barnea tiara, *Tate*. Muddy Creek. *a*, Left valve; *b*, accessory valve; and *c*, side view of the same.
2. Pecten subconvexus, *Tate*. Muddy Creek.
3. Panopæa orbita, *Hutton*. River Murray Cliffs.
4. Pecten deformis, *Tate*. Muddy Creek.
5. Tellina Cainozoica, *T. Woods*. Table Cape. Slightly enlarged.
6. Cytherea submultistriata, *Tate*; var. Cooke's Plains.
7. Cytherea eburnea, *Tate*. River Murray Cliffs.
8. Cytherea submultistriata, *Tate*. Muddy Creek.
9. Mytilus Hamiltonensis, *Tate*. Muddy Creek.
10. Sacchia suborbicularis, *Tate*. River Murray Cliffs. *a*, Right valve, enlarged; *b* and *c*, interior of left and right valve, much enlarged.
11. Lucina affinis, *Tate*. River Murray Cliffs. Enlarged.

Digitized by Google

Plate XIX.

1. Mytilus deperditus, *Tate*. Muddy Creek.
2. Solen sordidus, *Tate*. Muddy Creek.
3. Mytilus linguatulus, *Tate*. Muddy Creek.
4. Teredo sp. Muddy Creek. Enlarged.
5. Cryptodon mactræformis, *Tate*. Muddy Creek. Much enlarged.
6. Strigilla australis, *Tate*. Muddy Creek. Slightly enlarged.
7. Rhinomya latesulcata, *Tate*. Adelaide. Much enlarged.
8. Neæra Adelaidensis, *Tate*. Adelaide. Enlarged.
9. Lucina aræa, *Tate*. Aldinga. Enlarged.
10. Ostrea manubriata, *Tate*. Muddy Creek. Exterior and interior views of the attached valve.
11. Aspergillum (Humphreyia) liratum, *Tate*. Adelaide. Slightly enlarged.
12. Myodora prælonga, *Tate*. Muddy Creek. *a*, Right valve; *c*, its dorsal aspect; *b*, left valve; *d*, interior of the same.
13. Kellia micans, *Tate*. Muddy Creek. Enlarged.
14. Capistrocardia fragilis, *Tate*. River Murray Cliffs. *a*, Interior, and *b*, exterior of left valve. Enlarged.

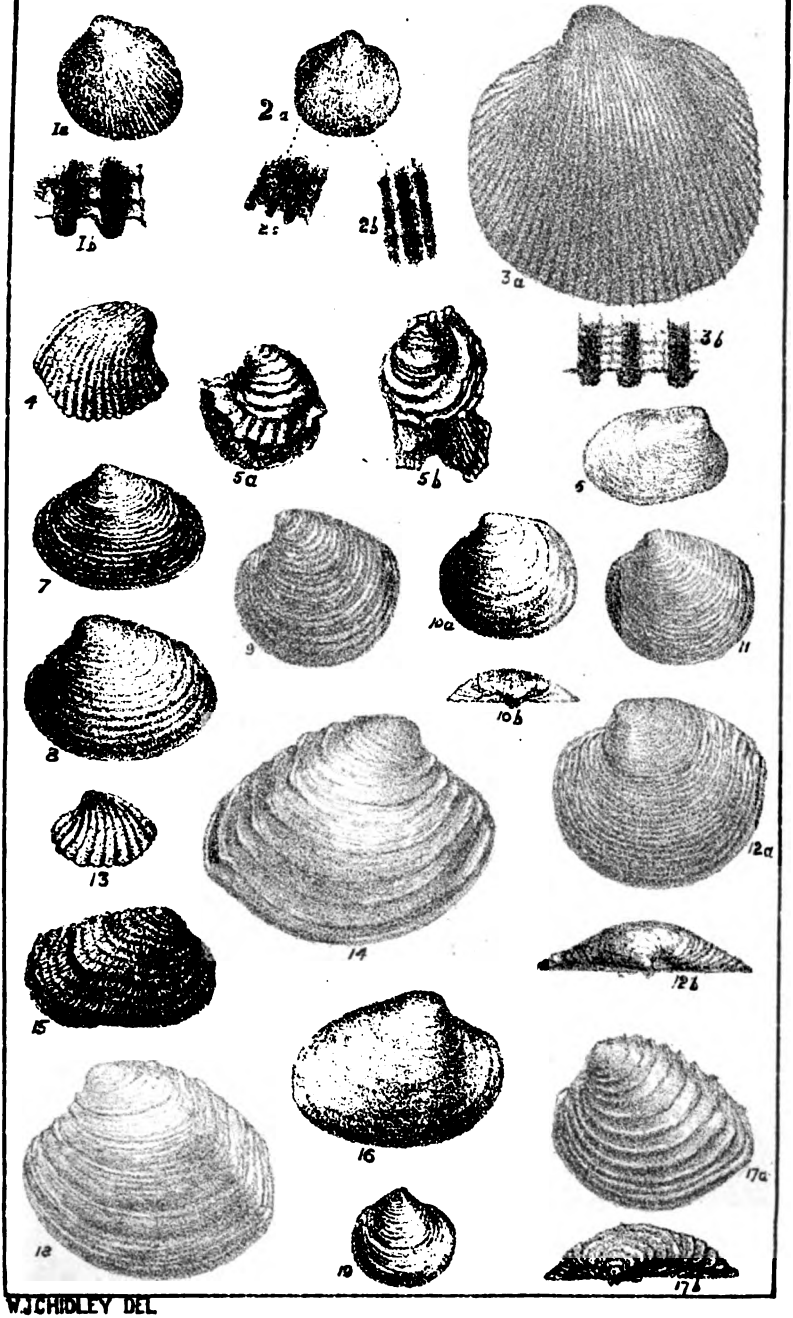
Plate XX.

1. Styliola annulata, *Tate*. Aldinga. Enlarged.
2. Styliola Rangiana, *Tate*. Muddy Creek. Much enlarged.
3. Dentalium triquetrum, *Tate*. Adelaide. Enlarged, natural size in outline.
4. Entalis subfissura, *Tate*. River Murray Cliffs. *a*, Natural size; *b*, apex enlarged.
5. Dentalium bifrons, *Tate*. Muddy Creek.
6. Entalis annulatum, *Tate*. Muddy Creek. *a*, Natural size, and *b*, apex enlarged.
7. Vaginella eligmostoma, *Tate*. Muddy Creek. Much enlarged; aperture in outline.
8. Dentalium aratum, *Tate*. River Murray Cliffs. Enlarged; natural size and transverse section in outline.
9. Styliola bicarinata, *Tate*. Muddy Creek. Enlarged; natural size and section in outline.
10. Cadulus mucronatus, *Tate*. (A very bad drawing.)
11. Entalis acriculum, *Tate*. Muddy Creek. Natural size, and apex enlarged.
12. Spiralis tertiaria, *Tate*. Muddy Creek. *a*, Base; *b*, front view; *c*, apical aspect. Much enlarged.
13. Lucina araneosa, *Tate*. Muddy Creek. Enlarged.
14. Cardita calva, *Tate*. Muddy Creek. Enlarged.

Digitized by Google

15. Lucina despectans, *Tate*. Muddy Creek. Young shell, much enlarged.
16. Lucina despectans, *Tate*. An older shell, enlarged.
17. Carditella multilamella, *Tate*. Muddy Creek. Enlarged.
18. Cardita solida, *Tate*. Muddy Creek. Enlarged.
19. Tellina equilatera, *Tate*. Muddy Creek. An adult shell.
20. Carditella polita, *Tate*. Muddy Creek. Fry, much enlarged.
21. Carditella polita, *Tate*. An adult shell, enlarged.

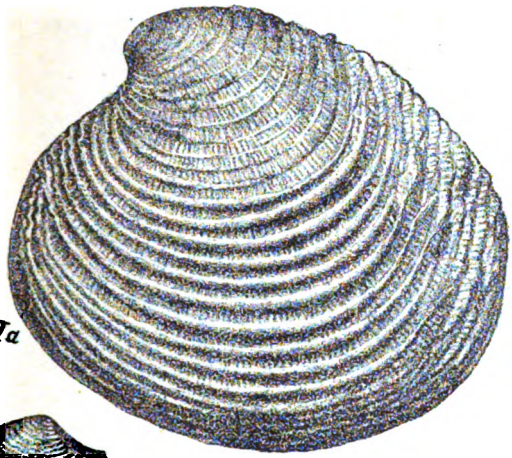
Digitized by Google

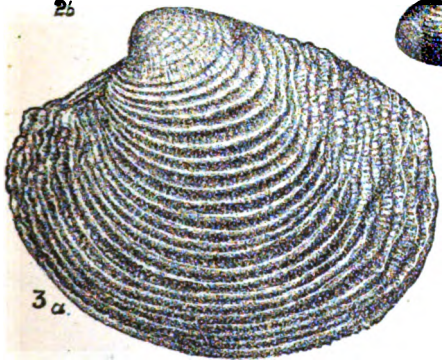


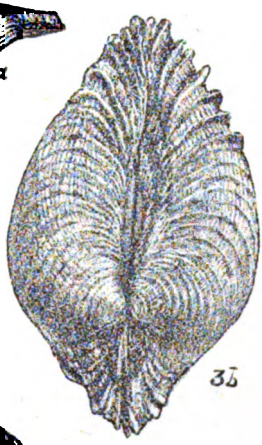
W.J.CHIDLEY DEL

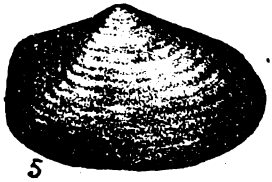
Digitized by Google

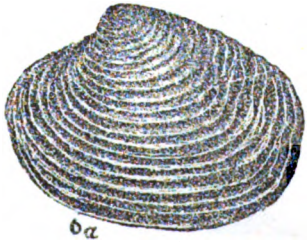
Digitized by Google











W.B.CHIDLEY DEL

Digitized by Google

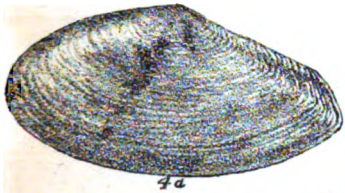
Digitized by Google

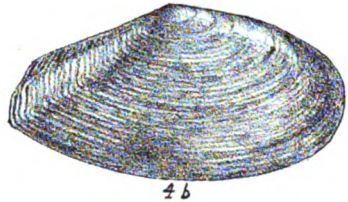
1

2

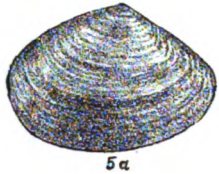
3b

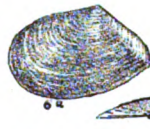
3a


4a


4b

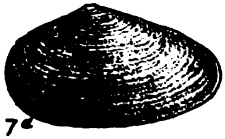
5b


5a


6a

6b

6c

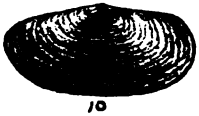

7a

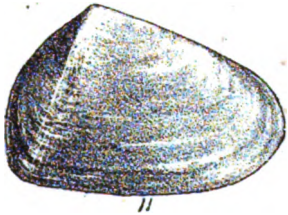
8

9a

7b

9b


10


11

12

13

14

15

16

17

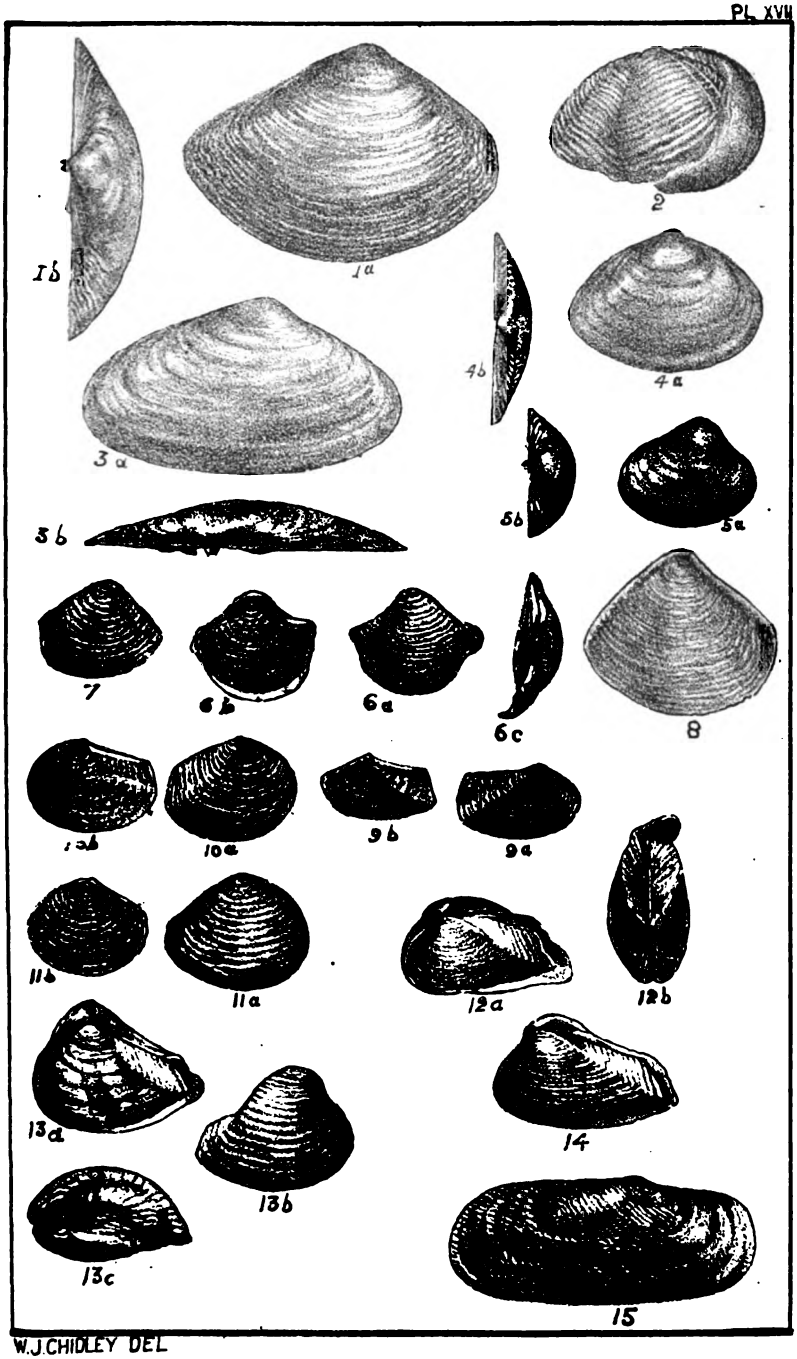
18b

18a

W.J.CHIDLEY. DEL.

Digitized by Google

Digitized by Google

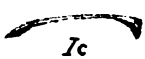


W.J.CHIDLEY DEL

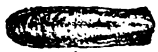
Digitized by Google

Digitized by Google

1a



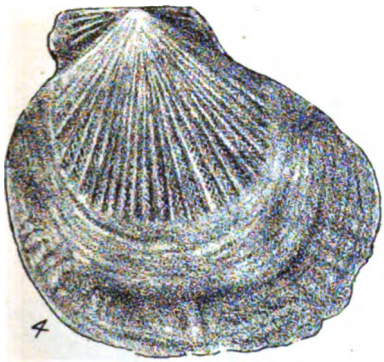
1c



1b

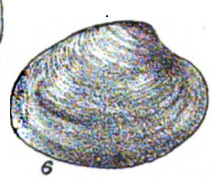
2

3

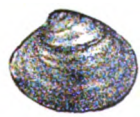


4

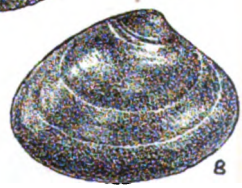
5



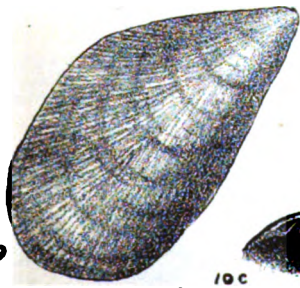
6



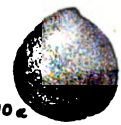
7



8



9



10a

10c

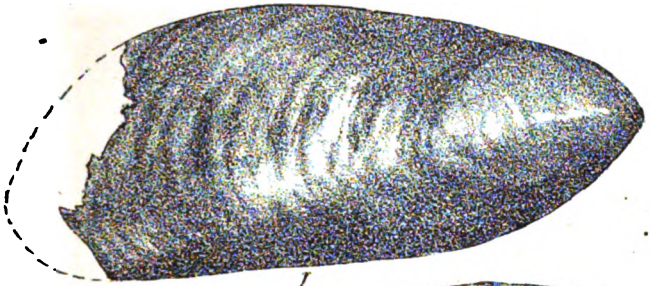
10b

11

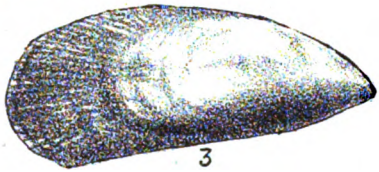
W.J. CHIDLEY DEL.

Digitized by Google

Digitized by Google


1

2


3

4

5

6

10

7

8

9

11

14a

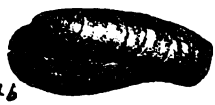
12a

12b

13

12c

12b


14b

W.J.CHIDLEY DEL

Digitized by Google

Digitized by Google

RING THE
ONDON TO

Soc., &c.

l I at once
un ordinary
mend it for
sually sup-
y means of
bulbs than
and mini-
ulbs. Self-
a, and the
to keep its
art of the
can be ob-
r will not
r by spray
mum. In
new form
commend.
ce a week,
s obtained
Board of
also hung
plete as I
tempera-
st impor-
d I found
the fore-
s from the
ber 20th,
st regular
bells."
ontaining
ort where

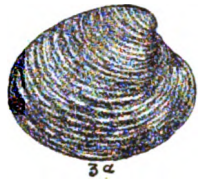
Digitized by Google

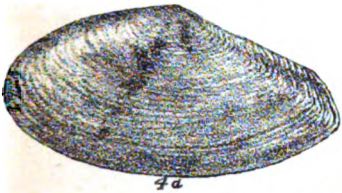
Digitized by Google

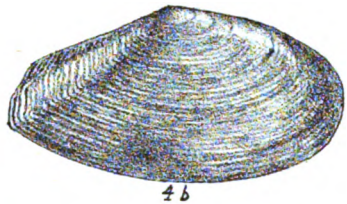
1

2

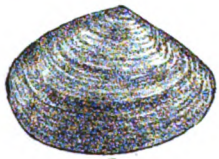
3b

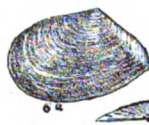

3a

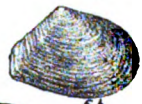

4a


4b

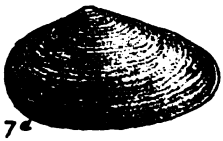
5b


5a


6a


6b

6c


7a

8

9a

7b

9b

10

11

12

13

14

15

16

17

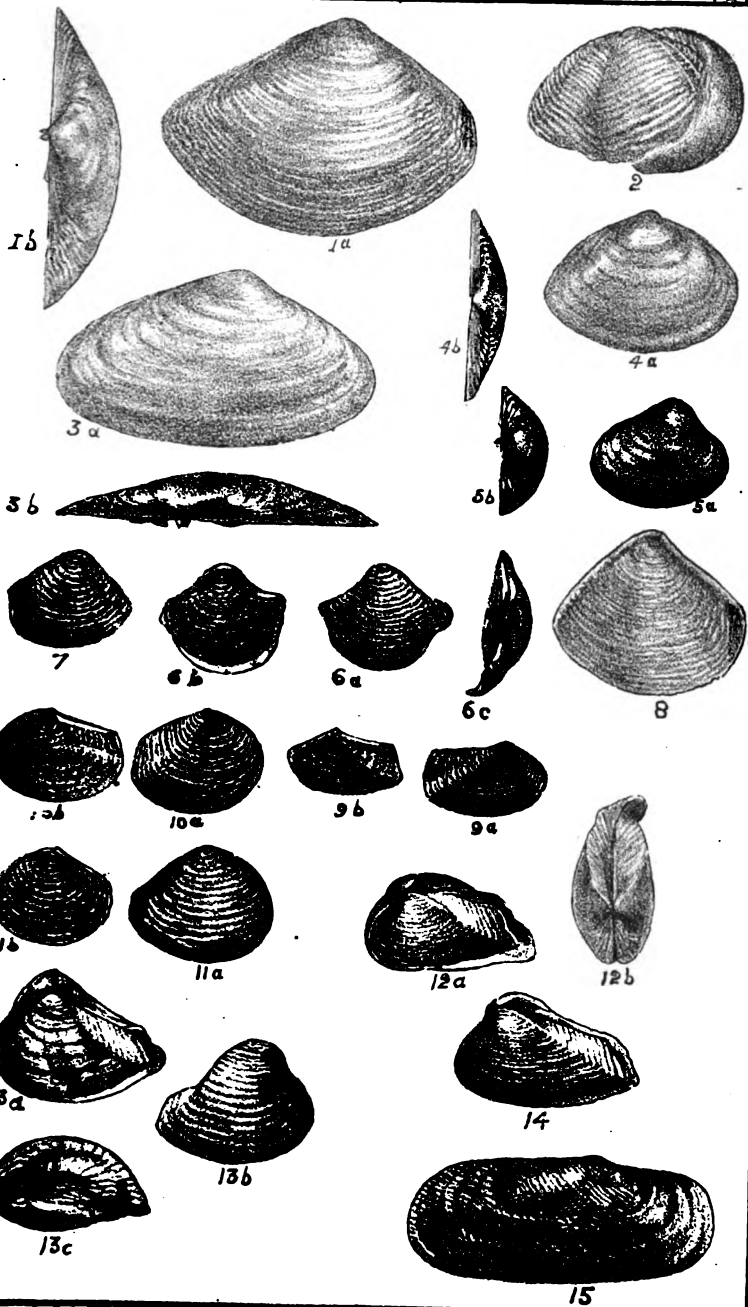
18b

18a

W.J.CHIDLEY. DEL.

Digitized by Google

Digitized by Google

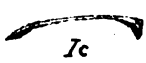


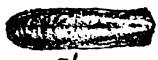
W.J.CHIDLEY DEL

Digitized by Google

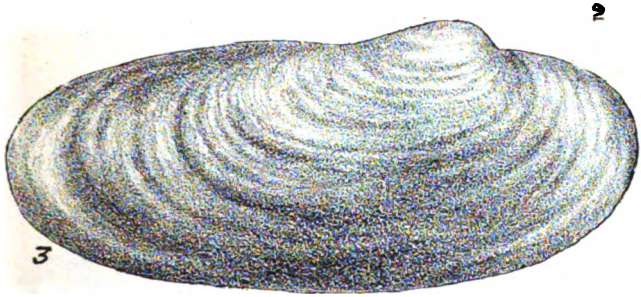
Digitized by Google

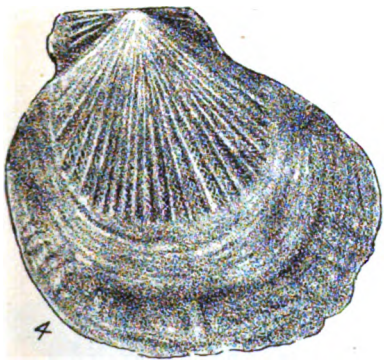
1a

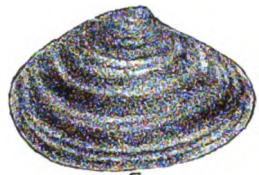

1c

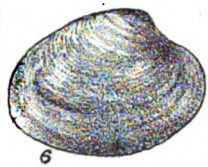

1b

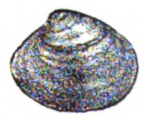
2

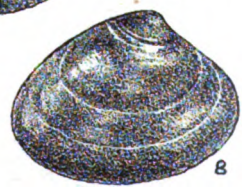

3

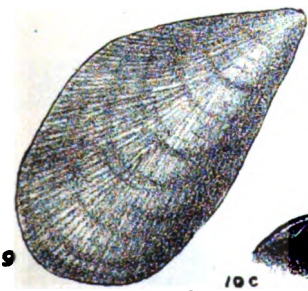

4

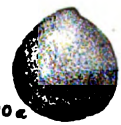

5


6


7


8


9


10a

10c

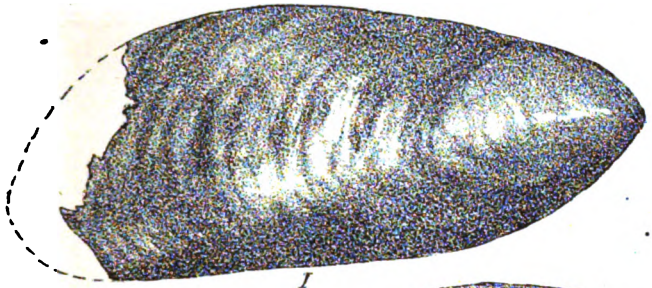
10b

11

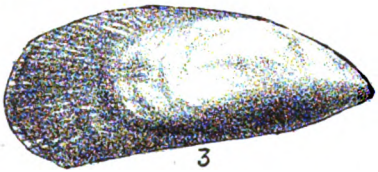
W.J.CHIDLEY DEL.

Digitized by Google

Digitized by Google


1

2

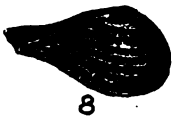

3

4

5

6

7


8

9

10

11

14a

12a

12b

12c

12b

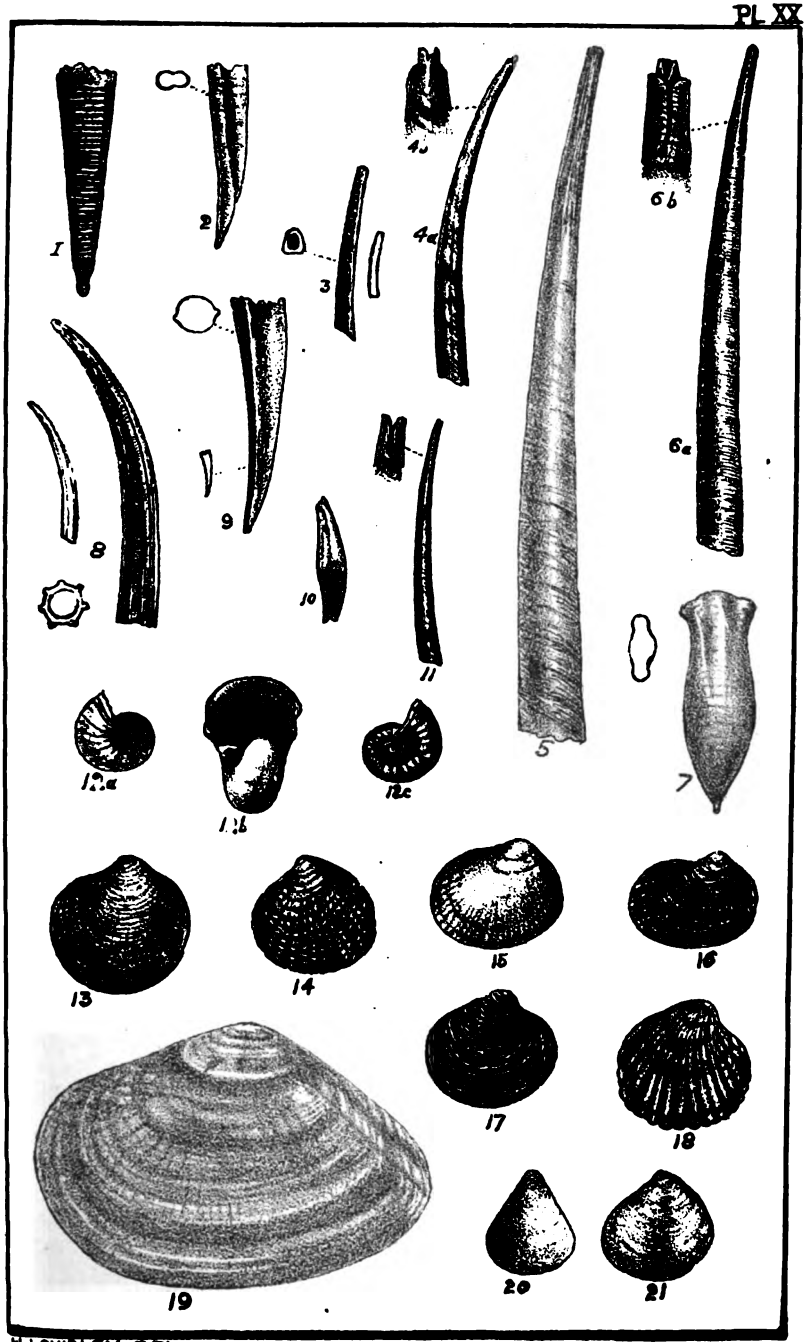
13

14b

W.J. CHIDLEY DEL

Digitized by Google

Digitized by Google



W.J.CHIDLEY. DEL.

Digitized by Google

Digitized by Google

Scientific Observations made during the Voyage of the Maranoa from London to Adelaide, 1883.

By Clement L. Wragge, F.R.G.S., F.R.Met.Soc., &c.

[Read June 2, 1885, and March 2, 1886.]

Plates XXI.-XXVI.

(abstract.)

We left Portland at 6.40 a.m., October 20th, and I at once proceeded to arrange my instruments. I employed an ordinary Stevenson's thermometer screen, and strongly recommend it for sea use in place of the Board of Trade wall screens, usually supplied to captains by the Meteorological Office. By means of it I obtained a better circulation of air around the bulbs than is possible with a wall screen, and I hung maximum and minimum thermometers therein, as well as wet and dry bulbs. Self-registering thermometers I find very necessary at sea, and the screen should be swung to a spar in such a way as to keep its perpendicular position, and if placed in the afterpart of the ship, near the taffrail, a good series of observations can be obtained, and the index in the minimum thermometer will not slip. Here the chance of vitiation of readings, either by spray or heat from the engine-room, is reduced to its minimum. In my cabin I swung a "Richard" aneroid barograph, a new form of recording barometer, which I can most cordially recommend. The instrument only needs setting and winding once a week, and a perfect and most valuable record of pressure is obtained throughout the voyage. My own mercurial, a fine Board of Trade barometer, having a total error of but 0·003, I also hung in my cabin, and my floating observatory was as complete as I could make it. I also determined to take sea-surface temperatures throughout the voyage, as this is one of the most important points in the problems of physical geography, and I found the best plan was to cast a little bucket from near the forecastle head, so as to be clear of the disturbing influences from the waste-pipes of the engine-room. At noon on October 20th, 28½ miles south-west from Portland, I took my first regular readings. Observations were usually made at "eight bells."

It is always my custom at sea to cast adrift bottles containing the ship's position, with a request to the finder to report where

Digitized by Google

picked up, in the hope of obtaining novel results as to the currents of the ocean. This practice was adopted during the Antarctic expeditions with much success, and I have already obtained valuable data from my own bottles sent adrift on former voyages.

After passing Ushant the Maranoa came into the region of Rennel's current, a stream much influenced by the seasons and winds. It follows the north coast of Spain, then sets north along the west of France, and runs at the rate of more than half a mile per hour. It passes the entrance of the English Channel, where it flows at a velocity of a mile an hour, and to it is attributed the loss of many vessels. One branch sets to Cape Clear, and another to St. George's Channel.

In lat. 46° 30′, long. 7° 10′ W., where the current sweeps up from the Bay of Biscay, I cast over three bottles addressed to the Meteorological Office, in the hope of testing seasonal change on this current. It appears, however, from my experiments of a *former* voyage—which I may mention as of passing interest—that bottles do not always drift with the current, but may to a greater extent than in the opinion of Maury be influenced by the winds. For instance, on May 17th, 1878, when in lat. 48° 19′ N., long. 10° 27′ W., a position somewhat to the *west* of this current, I cast over bottles under west-south-westerly winds. These, instead of following the drift, which is strong with west winds, went easterly, right across it, without loss of time. One was picked up on the island of Sein on July 12th, one in the Baie de Quiberon about August 21st, another on the coast of the Department of Finistère, and a fifth went up channel to Brighton Beach, and was picked up on October 8th following. On the present voyage, in lat 45° 40′ N., long. 7° 50′ W., where the Biscay current setting to east-south-east joins the loop of Rennel's current setting to west-north-west, I cast over a bottle, and in like manner it did not follow the current, but went right across it nearly at right angles, and was picked up four months afterwards on the coast of the Department of Loire-Inférieure.

Early on October 22nd we sighted the steep and broken coast line of North-West Spain, a formation which I connect with the Cretaceous period. I was enabled to take several sketches of this interesting scenery with its fiord-like inlets or *rias*. The action of sub-aerial denudation is very apparent in the rounded bluffs of Finisterre, and *débris* from the weathering action of Atlantic storms is seen in many a talus on the wild declivities of this littoral. Near Cape Carvoeiro the weathering action on the ruddy white chalk is again very apparent, and masses of *débris* cover the cliffs.

When passing near Lisbon another bottle was sent adrift.

Digitized by Google

The Maranoa was then in the Portugal current which flows from Cape Finisterre, then south-south-east, coming very near to the coast, and after rounding Cape St. Vincent joins that portion of the North African current which enters the Mediterranean. I expected that my bottles would have followed this course, and was much surprised when, through the kindness of Messrs. Blandy, of Madeira, I received the original bottle-paper which had, instead, travelled south-west, and was picked up by fishermen on the south beach of Porto Santo barely three months afterwards (January 14th, 1884). Messrs. Blandy in their letter to me say—"It is a strange thing it having turned up there, as we have very distinct proofs of the current running usually from north-west past our group of islands. From Christmas until 15th January, however, we experienced a very unusual spell of south-east winds veering continually between east and south, and evidently of abnormal influence."

The mountainous ridge terminating in Cape Spartel is an imposing feature of much interest to the geologist. Alternating, however, with the bold escarpments of this portion of the coast are low and undulating tracts, evidently the waste material from the softer parts of what was once a higher range.

The following sea-surface temperatures are worthy of special note:—On October 23rd at 8 p.m, on coming up to Cape St. Vincent, 60·4° was the value. At 8 a.m. next day when passing abeam of the mouth of Guadalquiver, and about 80 miles distant, 65·0° was recorded. At noon, when 40 miles from Cadiz, the temperature of the water had fallen 3·2°, and afterwards appeared steadily to rise till 66·0° was registered at 8 p.m. in the Strait. The discharge of the waters draining the heated plains of Andalusia, and the influence of the converging land, may tend to explain these temperatures.

The famous "red glow" was first noticed at sunset on the 30th October. East of the 24th meridian intense vapour bands were observed to the left of D in the spectrum throughout the day at seven degrees above horizon. At times these bands were almost black, but usually faded off with elevation of the instrument to the zenith. This extraordinary intensity of the rain-band in the clear skies of the Levant I attribute to the excess of vapour accumulated over the sea, and rapid evaporation, and cannot establish a connection between them and the sunset displays.

Port Said was reached on the morning of November 1st, and soon afterwards we entered the Suez Canal.

I was much gratified to find that since my last passage through the Canal (in 1874) a belt of vegetation had sprung up on many parts of the banks, acting as a natural barrier to the sand-dust, which otherwise would drift rapidly into the

Digitized by Google

bed of the canal. *Arundo phragmites*, *gnaphalium*, and a species of lotus appear to prevail. At Ismailia I went ashore by special arrangement, and on the shores of Lake Timsah I obtained many specimens of marine mollusca, including *Cardium edule*, *Mactra solida*, and *Mytilus*, which the Arabs affirmed had migrated from the Red Sea.

The maximum air temperature during the passage of the Canal was 77·3, and the minimum 61·0°. The barometer, fully reduced, ranged between 30·080 and 29·904 during the passage of the Canal.

I may mention that the highest sea surface temperature yet observed is 94° near the Strait of Bab-el-mandeb. On looking at the synopsis of this section it will be seen that 88·9° was the highest observed on this passage in lat. 17° 45′ N. The mean temperature of the Red Sea water north of latitude 20° is 77° 4′, and south of that parellel 81° 5′. In many parts of the Red Sea the water is intensely blue, the colour being quite as deep as in the Mediterranean. I observed this more particularly in lat. 26° 20′ N. The cause of this blue colour appears as yet to be imperfectly understood, and probably will remain so until the perfection of a sub-aqueous exploring telescope, as suggested by Sir J. F. W. Herschel, Bart., in the fourth edition of the "Admiralty Manual of Scientific Enquiry," has been realised.

At Aden I secured several specimens of metamorphic slates and calcite with some pieces of tracytic or felspathic lava.

We sailed from Aden on November 8th as the north-east monsoon was becoming established, and on 10th we passed Socotra, an admirable position for a high-level meteorological station by the way, being 4,656 feet high. In this neighbourhood I observed many fine specimens of *Acalephæ*, purple "jelly-fish," probably the *Æquorea purpurea*. They abounded in great numbers. *Exocietas volitans* was also prevalent. Here again the water was of a deep blue colour. Intense vapour bands were observed during this section to the left of the D line in the spectrum at 7° above horizon as in the Mediterranean and Red Sea.

The prevailing upper wind current was N.E. by E., the clouds travelling with a velocity of about 2·5 on a scale of 0 to 10. The skies of the north-east monsoon are truly splendid, and the cloud-forms often exceedingly curious. One instance only I can mention. On November 14th, after sunset, against a golden background, rose as from the offing dark cumuli of most grotesque shapes. They resembled trees, branches, islands, rocks, and even solar prominences, with heavy cumulo-stratus stretched above, while the full moon at the opposite azimuth, on a sky of grey blue and reflected on the water, added charm to the picture. I merely mention this because many travellers

Digitized by Google

having a knowledge of photography might add very largely to meteorological science by taking cloud pictures in various latitudes.

The high values for relative humidity at sea will interest those who have not given special attention to meteorology, especially when it is remembered that 25 and 15 are not unusual percentages for this element in the dry summer climate of the Adelaide Plains. In the latter a percentage of nine, with a difference of over 36° between the dry and wet bulbs, has quite recently been recorded at the Torrens Observatory, lately established by me, two miles north-east from Adelaide.

Digitized by Google

Section I.—Portland to Gibraltar, *viâ* Ushant, Cape Finisterre' the Burlings, and St. Vincent—direct courses. October 20th to 24th, 1883.

Meteorological Synopsis.

(N.B.—The synoptic extremes are in large type; elements to compare therewith in small type.)

Date.	Hour.	Bar. fully reduced.*	Dry bulb.	Wet bulb.	Difference.	Vapour tension.	Relative humidity per cent.	Dew point.	Wind.	Miles per hour	Cloud.	Amt. of cloud scale, 0 to 10	Weather by Beaufort notation.	Air temperature.	Water temperature.	Position and remarks.
Oct.																
20	4 to 8 p.m.	—	—	—	—	—	—	—	W.	31	Types of cumulus.	—	c	50·8	—	About 60 miles N.E. from Ushant.
20	8 p.m.	—	51·9	47·0	4·9	·267	69	42·0	S.W.	34	Dark cumulus.	2	c^c	—	55·2	About 40 miles N.E. from Ushant.
21	noon	—	52·0	50·3	1·7	·343	88	48·6	W.	18	Nim., cum., cir-s.	7	c^3	—	59·1	Lat. 46deg. 50m. N. Long. 6deg. 50m. W.
22	noon	30·300	60·0	53·9	6·1	·342	66	48·5	N.	13	A little cumulus.	2	c_0	—	57·8	Cape Finisterre on port quarter.
24	4 to 8 p.m.	30·140 to 30·190	—	—	—	—	—	—	E.	About 34	Generally clear.	—	b or c^0	66·7	—	Entering Strait. Strong head sea.
24	8 p.m.	30·190	63·0	60·1	2·9	·477	83	57·7	E. by S.	18	Clear.	—	b^3	—	66·0	In the Strait.
														Range. 15·9	Range. 10·3	

* Barometer reduced to 32 deg. F., and sea level always.

Remarks.—Sea-surface temperature increased 4 degs. during the passage of the Bay of Biscay, where passing showers and counter-trades from W.S.W. were experienced. No marked fluctuations of atmospheric pressure, but it steadily gave way on approaching the African mainland. Highest value by Moffat's ozone tests, pinned inside the thermometer screen, 5.2 (scale 0 to 10), for periods of four and twelve hours; less than values obtained in the Moorlands of Staffordshire and Highlands of Scotland for similar periods of exposure.

Digitized by Google

Section II.—Gibraltar to Malta, *vid* Cape Tennez, Algiers, and Cape Bon—direct coastal courses; October 24 to 28.

Meteorological Synopsis.

(N.B.—The synoptic extremes are in large type; elements to compare therewith in small type.)

Date.	Hour.	Bar. fully reduced.	Dry bulb.	Wet bulb.	Difference.	Vapour tension.	Relative humidity per cent.	Dew point.	Wind.	Miles per hour	Cloud.	Amt. of cloud, scale 0 to 10.	Weather by Beaufort notation.	Air temperature.	Water temperature.	Position and remarks.
Oct.																
24	10.30 p.m.	30·184	*63·5	59·9	2·6	·477	84	57·7	E.	18	Generally clear.	0	b	—	—	In Strait of Gibraltar.
24-25	Midnight.	30·184	63·0	59·7	2·3	·478	86	57·7	E.	18	Clear.	0	b.w.[2]	—	61·6	About 44 miles east by south from Gibraltar.
25	During 8 hours ending 8 a.m.	—	—	—	—	—	—	—	E. by S.	20	Generally clear.	0	b	61·0	—	Estimated at 90 miles east from Gibraltar. Colour of water, deep inky blue.
26	2 a.m.	30·053	*66·9	63·5	3·4	·534	81	60·8	E.	23	Generally clear.	—	—	—	—	About 20 miles N.E. by E. from Cape Tennez.
26	Noon.	30·104	72·0	65·0	7·0	·514	65	59·7	E.	18	Light cirriforms.	3	c	—	66·9	Lat. 37deg. 02m. N. Long. 4deg. 07m. E. Water deep blue.
26	Noon to 4 p.m.	30·104	—	—	—	—	—	—	E.	18	Generally clear.	—	—	73·4	—	About 70 miles E.N.E. from Algiers.
27	4 p.m.	30·113	66·7	60·4	6·3	·439	67	55·4	E.N.E.	13	Cumulus and cumul.	4	c	—	70·2	Cape Bon nearly abeam, 2½ miles distant. Water very deep blue.
		Range, 0·131												Range, 12·4	Range, 8·6	

* Hygrometric values interpolated.

Notes.—Pressure remained generally steady—the curve gently rising between 5 a.m. and 9 a.m. (owing to chilly morning air and accumulation of vapour), and dipping between 10 a.m. and 6 p.m. (due to decrease of evaporation and expansion of air by afternoon heat). Easterly winds travelling round the northern edge of the cyclonic area of Sahara entirely obtained, accompanied with intense "visibility" and terrestrial refraction. Ozone tints ranged between 3·5 and 5·6 for four and eight hours respectively.

Digitized by Google

METEOROLOGICAL SYNOPSIS.

(N.B.—The synoptic extremes are in large type; elements to be compared therewith in small type.)

Date.	Hour.	Bar. fully reduced.	Dry bulb.	Wet bulb.	Difference.	Vapour tension.	Relative humidity per cent.	Dew point.	Wind.	Miles per hour	Cloud.	Amt. of cloud, scale 0 to 10.	Weather by Beaufort notation.	Air temperature.	Water temperature.	Position and Remarks.
Oct. 29	—	—	—	—	—	—	—	—	E. to N.E. then veering S.	—	Ugly cumulus nimbus, and cirro-status.	About 6	n cz	60·5	—	Within 300 miles E.S.E. from Malta, under conditions of barometric depression, accompanied by rain-squalls and thunderstorm.
29	8 a.m.	Steady at 29·963	66·8	63·9	2·9	·550	84	61·6	N.E.	13	Cirri forms & cumulus.	7	cz	—	71·3	About 150 miles E.S.E. from Malta; also about 8 p.m.
29	Noon.	Steady at 29·947	69·0	64·2	4·8	·524	74	60·5	S.S.E.	13	Filmy cirriforms, cumulus.	6	c	—	72·4	Lat. 34deg. 55m. N., long. 18deg. 52m. E. Water deep blue.
30	10 p.m.	Steady at 30·140	*70·6	*64·8	5·8	·526	70	60·4	S.Ely	11	Generally clear.	0	b	—	—	Lat. 33deg. 0m. N., long. 26deg. 20m. E. Dewy night; lightning on western horizon.
31	Noon.	30·102 Range, 0·193	75·0	65·3	9·7	·488	56	58·3	Var. airs.	4	Cumulus types.	5	c	76·8 Range, 16·3	76·9 Range, 5·6	Lat. 32deg. 15m. N., long. 29deg. 8m. E. Water deep blue. N.B.—Max. air temp. occurred in forenoon.

Hygrometric values interpolated.

NOTES.—With the exception of a slight cyclonic depression between the 28th and 30th, the barographic curve was steady. Thunder, lightning, and heavy rain-squalls occurred in front of the disturbance, with the usual south-easterly winds on the N.E. side. No high value for ozone was recorded.

Digitized by Google

Plate XXI.

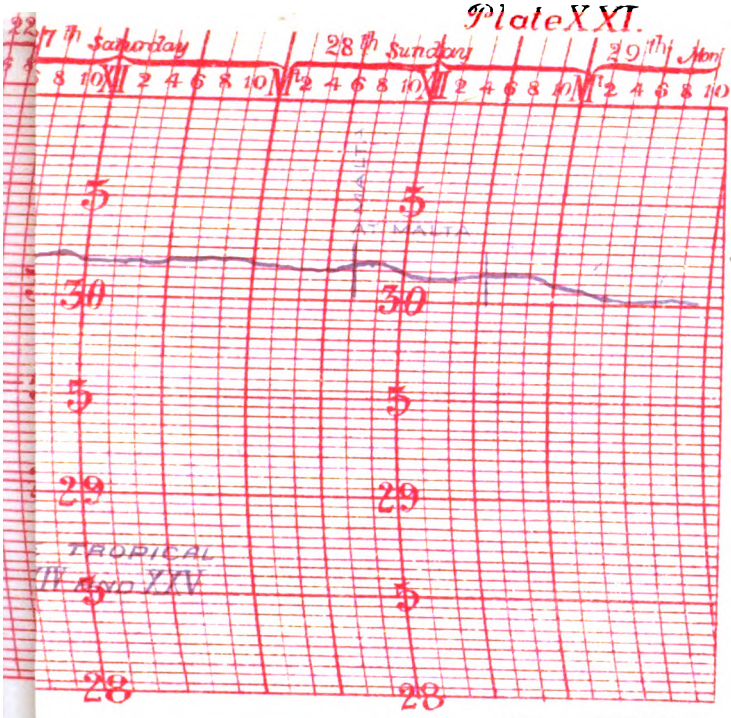
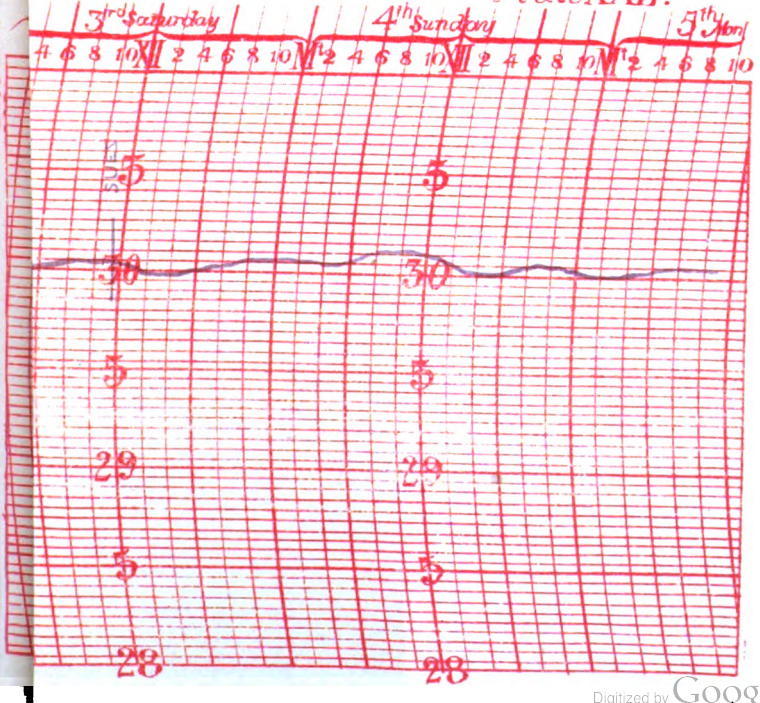


Plate XXII.



Digitized by Google

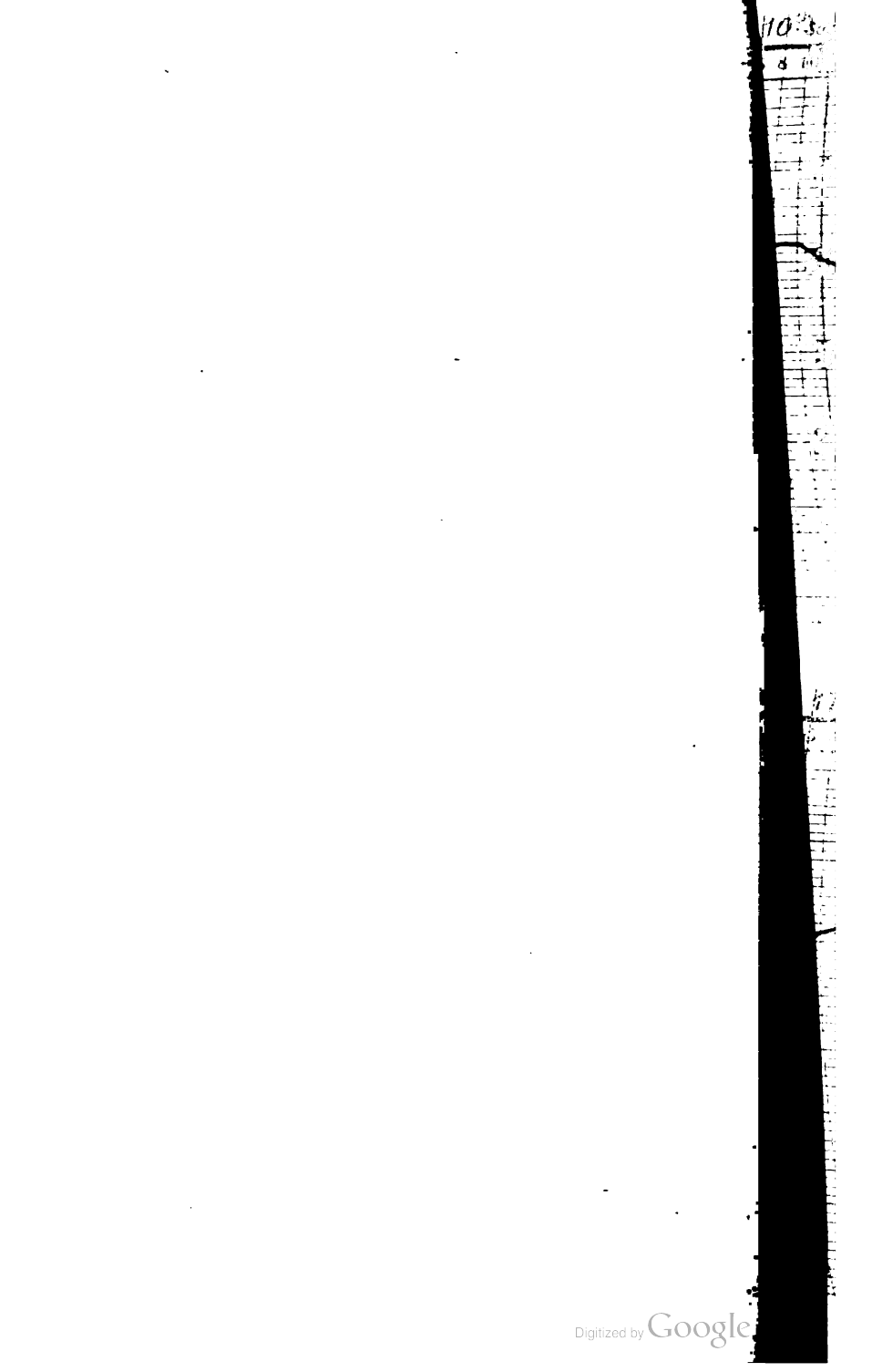
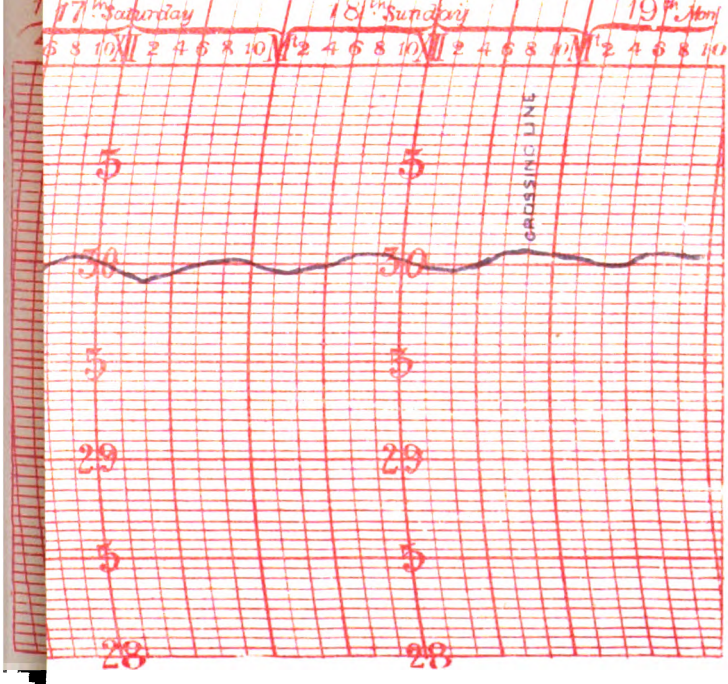

Digitized by Google

Plate XXIV.



Digitized by Google

Digitized by Google

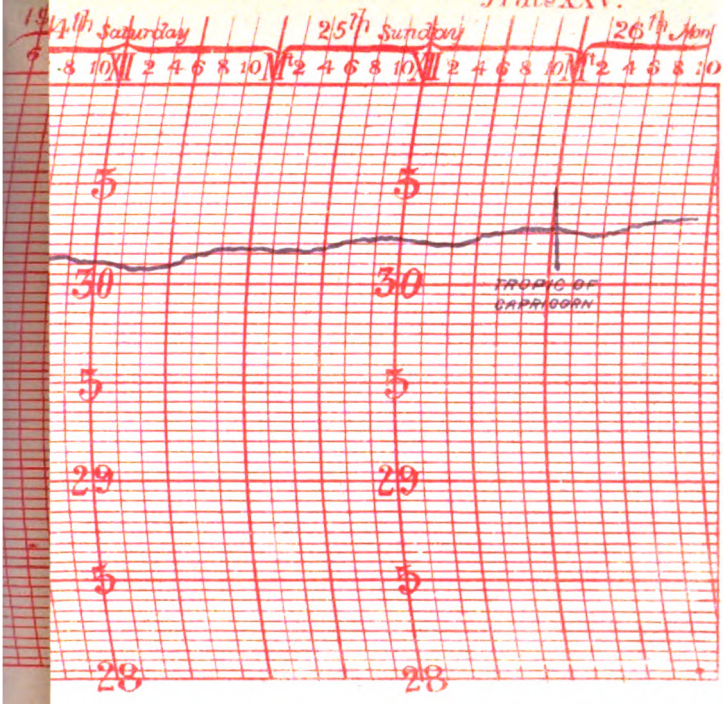
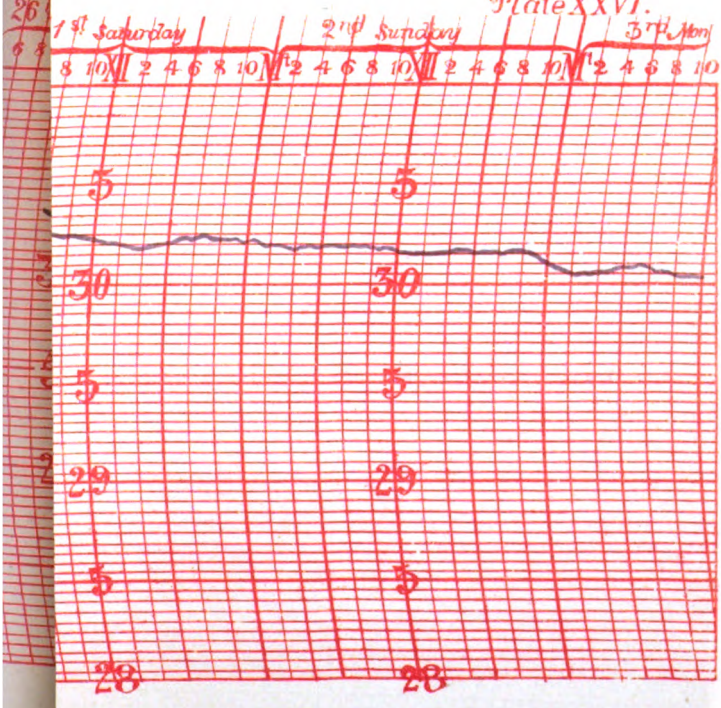


Plate XXVI.



Digitized by Google

Digitized by Google

METEOROLOGICAL SYNOPSIS (SUEZ TO ADEN).

(N.B.—The synoptic extremes are in large type; elements to compare therewith in small type).

Date.	Hour.	Bar. fully reduced.	Dry bulb.	Wet bulb.	Difference.	Vapour tension.	Relative humidity, per cent.	Dew-point.	Wind.	Miles per hour	Cloud.	Amt. of cloud, scale 0 to 10.	Weather by Beaufort notation.	Air temperature.	Water temperature.	Position and remarks
Nov., 1883.																
3	4 p.m.	29·916	74·1	62·7	11·4	·426	51	54·4	Wly.	25	Cumulus.	7	c	70·1	75·3	About 50 miles south from Suez. Colour of water white-slate. Sea rather rough.
3	8 p.m.	29 964	74·0	62·5	11·5	·422	50	54·1	Wly.	18	Loose cumulus.	4	c	—	—	About 88 miles from Suez. Air warm and soft.
4	10 a.m.	30·065	*74·3	63·7	10·6	·451	53	56·0	N.Wly.	About 18	—	—	—	—	—	Lat. about 23deg. 20m. N.
6	4 p.m.	29·901	84·8	77·1	7·7	·789	65	72·1	Calm.	3	Cumulus, cirro-cumulus.	4	c	—	88·9	Lat. 17deg. 45m. N. Long. 40deg. 0m. E., approximate. Heavy dew at night.
6	about 6 p.m.	29·921	*83·9	77·3	6·6	·810	69	73·0	Calm.	3	—	—	—	87·6	—	Lat. 17deg. 30m. N. Long. 40deg. 30m. E., approximate. Lightning shortly to W.N.W.
7	4.15 a.m.	29·926	80·0	78·5	1·5	·942	93	77·5	Sthly.	13	—	—	—	—	80·6	Coming up to Jebel Teir.
		Range, 0·164												Range, 17.5	Range, 13·6	

* Hygrometric values interpolated.

NOTES.—Strong rainbands were frequently observed in the spectroscope at 7 deg. above the horizon during the Red Sea passage. As in the earlier part of the voyage, I obtained no high values for ozone, using Moffats' tests, 5 0, on a scale of 0 to 10, being never exceeded.

Digitized by Google

Section V.—Aden to Colombo, direct course, November 8th to 16th.

Meteorological Synopsis.

(N.B.—The synoptic extremes are in large type; elements to compare therewith in small type.)

Date.	Hour.	Bar. fully reduced.	Dry bulb.	Wet bulb.	Difference.	Vapour tension.	Relative humidity per cent.	Dew point.	Wind.	Miles per hour	Cloud.	Amt. of cloud, scale 0 to 10.	Weather by Beaufort notation.	Air temperature.	Water temperature.	Position and remarks.
Nov 1883																
8	4 p.m.	30·001	83·9	76·9	6·0	·809	72	72·8	E. by N.	18	Cumulus cumuli.	2	c*	—	83·2	About 12 miles from Aden. Sea slight. Water a deep bluish slate colour.
9	8 a.m.	30·028	79·4	75·2	4·2	·796	79	72·3	E. by N.	18	Types of cumulus.	5	c	—	81·1	About 187 miles east from Aden. Sea a deep slate-blue. North-east monsoon setting in.
10	8 a.m.	30·005	76·8	73·9	2·9	·763	85	71·8	N.E. by E.	13	Cumulus cumuli, loose cumulus.	4	c	—	78·2	Off the Island of Abd-al-Kurl. Colour of water a strong blue, with tint of green.
10	4 p.m.	29·903	82·7	75·8	6·9	·763	68	71·3	N. by N.	8	Cumulus cumuli, loose cumulus.	3	c	*85·2	—	About 30 miles south from Boodra.
15	4 p.m.	29·831	79·8	76·7	3·1	·858	85	74·6	Calm.	3	Cumulus, cumulo-stratus, cirro-cumulus	6	c	—	81·9	Lat. 7deg. 43m. N., long. 77deg. 3m. E. About 40 miles S.W. from Cape Comorin. At anchor off Colombo.
		Range, 0·197												75·1 Range, 10·1	Range, 5·0	

* Also on the 15th, read at noon.

Arrived at Colombo November 16th. While at Colombo, between 7 a.m., November 16th, and 1 a.m., 17th, the barometer merely presented the phenomenon of the ordinary diurnal tropical curve. Temperature ranged between 87·8 and 73·5, and the value for ozone was 3·0.

Digitized by Google

METEOROLOGICAL SYNOPSIS.

(N.B.—The synoptic extremes are in large type; elements to compare therewith in small type).

Date.	Hour.	Bar. fully reduced.	Dry bulb.	Wet bulb.	Difference.	Vapour tension.	Relative humidity, per cent.	Dew point.	Wind.	Miles per hour	Cloud.	Amt. of cloud, 0 to 10.	Weather by Beaufort notation.	Air temperature.*†	Water temperature.	Position and remarks.
Nov., 1883.																Sea very smooth. Colour of water, deep blue. Came across floating pumice. Lat. 5deg. 50m. S.; long. 89deg. 45m. E., approximate.
20	4 p.m.	29·812	81·5	73·0	8·5	·668	62	67·3	S.E. by E.	13	Cumulus, cum. stratus, cirro-cumulus	9	c^2	83·8	82·9	
23	Noon.	29·862	76·0	75·3	0·7	·863	96	74·8	S.E. by E.	32	Cirrus and cirro-stratus, with cum. and loose cum. beneath.	7	c	—	77·3	Ship pitching heavily. Colour of water, deep blue. Lat. 13 deg. 46m. S. Long. 94deg. 50m. E.
25	8 p.m.	30·103	68·8	66·4	2·4	·606	86	64·5	E.S.E.	28	Spreading and detached cumulus.	7	c	68·8	71·2	Lat. 22deg. 40m. S.; long. 95deg. 15m. E., approximate. Ship pitching; wild squally night.
25	10 p.m.	30·128	—	—	—	—	—	—	E.S.E.	28	—	—	—	—	—	Conditions of weather generally same as above. Lat. 23deg. 5m. S.; long. 95deg. 17m. E., approximate.
		Range. 0·316												Range, 15·0	Range, 11·7	

* As observed, self-registering thermometers had to be removed.

† Within last four hours.

Digitized by Google

Section VII.—The Tropic of Capricorn, in longitude 95° 30′ E., to Adelaide, Largs Bay.

Meteorological Synopsis.

(N.B.—The synoptic extremes are in large type; elements to compare therewith in small type.)

Date.	Hour.	Bar. fully reduced.	Dry bulb.	Wet bulb.	Difference.	Vapour tension.	Relative humidity, per cent.	Dew point.	Wind.	Miles per hour	Cloud.	Amt. of cloud, 0 to 10.	Weather by Beaufort notation.	Air temperature.*	Water temperature.	Position and remarks.
1883.																
Nov. 26	8 a.m.	30·184	69·2	61·0	8·2		59	54·6	E.S.E.	28	—	—	q	69·2	—	Weather squally and rainy. Lat. 24 deg. 40m. S.; long. 95deg. 40m. E., approximate.
Nov. 26	Noon.	30·155	67·7	62·0	5·7	·474	69	57·5	E.S.E.	23	Compact and fleecy cumulus.	8	c	—	68·1	Lat. 25deg. 15m. S. Long. 95deg. 47 m. E.
Nov. 27	10·15 a.m.	30·416	—	—	—	—	—	—	S.E. by S.	23	—	—	—	—	—	Lat. 28deg. 40m. S.; long. 97deg. 45m. E., approximate.
Dec. 1	4·15 p.m.	29·991	67·2	61·1	2·1	·506	88	59·3	E. by S.	34	Forms of cirrus cumulus and stratus.	3	c	—	58·9	Lat. 35deg. 45m. S.; long. 116deg. 0m. E., approximate.
Dec. 4	About 8 a.m.	29·709	59·0	59·0	0·0	·500	100	59·0	N.	13	Pallium of fog.†	10	—	59·0	60·3	About 160 miles E.S.E. from Recherche Archipelago.
Dec. 4	11 p.m.	29·467	—	—	—	—	—	—	N.E.	18	—	—	—	—	—	During thunderstorm in Australian Bight.
		Range, 0·949												Range, 10·2	Range, 9·2	

* As observed.

† Absolute saturation and conditions of fog observed also at other times in these latitudes.

Digitized by Google

MISCELLANEA.

PLANTS COLLECTED IN THE VICINITY OF THE MULLIGAN RIVER by Mr. W. H. CORNISH during his Survey Expedition in 1885; enumerated by BARON VON MUELLER, K.C.M.G., M.D., Ph.D., F.R.S.

Erysimum Blennodia, *F. v. M.*
Tribulus hystrix, *R. Brown.*
Zygophyllum Howittii, *F. v. M.*
Lavatera plebeja, *Sims.*
Sida corrugata, *Lindley.*
Sida rhombifolia, *Linné.* A variety with long-awned fruitlets, much like that illustrated by Cavanilles (Dissert. I., t. 12, fig. 2), but the leaves more like those of *S. virgata;* thinly velvety on both sides, and the flower-stalks much elongated. This particular plant was referred to by Bentham, as found on the Comet and Nicholson Rivers. A good distinguishing name would be *atherophora.*
Melhania incana, *Heyne.*
Owenia acidula, *F. v. M.*
Frankenia lævis, *Linné.* One of its numerous forms.
Claytonia Balonnensis, *F. v. M.*
Ptilotus obovatus, *F. v. M.*
Ptilotus alopecuroides, *F. v. M.*
Ptilotus helipteroides, *F. v. M.*
Rhagodia spinescens, *F. v. M.* The variety with deltoid leaves.
Alternanthera triandra, *Lamarck.*
Atriplex leptocarpum, *F. v. M.*
Kochia villosa, *Lindley.*
Chenolea bicornis, *F. v. M.*
Chenolea Cornishiana, *F. v. M.*
Chenolea quinquecuspis, *F. v. M.*
Enchylæna tomentosa, *R. Brown.*
Salsola kali, *Linné.* The variety with strobilaceous crowded fruits.
Mesembrianthemum æquilaterale, *Haworth.*
Codonocarpus cotinifolius, *F. v. M.*
Crotolaria linifolia, *Linné, fil.*
Crotolaria Cunninghami, *R. Brown.*
Crotolaria dissitiflora, *Bentham.*
Crotolaria Mitchelli, *Bentham.*
Psoralea patens, *Lindley.*
Trigonella suavissima, *Lindley.*

Digitized by Google

Indigofera hirsuta, *Linné.*

Ptychosema trifoliolatum, *F. v. M.* This remarkable plant has been recently obtained by Mr. H. Andrae at Pulpulla, in New South Wales. *Legume glabrous*, oblong-linear, flat, hardly more than one inch long; seeds generally eight to nine, roundish; funicle short; strophiole none. Should on discovery of the fruit of the typical *P. pusillum* it be found needful to separate the two species generically, then for *P. trifoliolatum* the name *Cornishia* may be chosen.

Sesbania aculeata, *Persoon.*

Swainsona microphylla, *A. Gray.*

Swainsona oligophylla, *F. v. M.*

Æschynomene Indica, *Linné.*

Glycine sericea, *Bentham.*

Bauhinia Leichhardti, *F. v. M.*

Acacia aneura, *F. v. M.*

Eucalyptus pachyphylla, *F. v. M.* The anthers occur roundish, so that this species could be transferred to the series of *Strongylantheræ.*

Eucalyptus terminalis, *F. v. M.*

Eucalyptus microtheca, *F. v. M.*

Annamannia multiflora, *Roxburgh.*

Haloragis Gossei, *F. v. M.*

Didiscus glaucifolius, *F. v. M.* Imperfect specimens with blue flowers, seemingly referable to this species. The normal form has been gathered on the Barcoo by the Rev. T. Flierl, and on the Paroo by Mrs. Spencer.

Santalum lanceolatum, *R. Brown.*

Grevillea juncifolia, *Hooker.*

Grevillea stenobotrya, *F. v. M.*

Spermacocce marginata, *Bentham.* A variety remarkable for the narrowness of its leaves and calyx lobes.

Minuria Candollei, *F. v. M.*

Calotis porphyroglossa, *F. v. M.*

Pterocaulon sphacelatus, *Bentham.*

Helipterum pterochætum, *Bentham.*

Helichrysum apiculatum, *DeCandolle.*

Helichrysum semicalvum, *F. v. M.* Referred by Bentham to the genus Leptorrhynchos, but best kept under Helichrysum. Concerning *L. linearis*, it may be noted that it constitutes merely a form of *L. squamatus*, but Bentham's plant of that name is *L. nitidulus*, and as such it is given already in my second report, p. 12 (1854). Mr. A. M. Howitt found it recently on Meriman's Creek. *L. pulchellus* has been gathered as far west as Fowler's Bay by Mrs. Richards. *L. tenuifolius* extends to Gippsland and to Lake Bonney.

Digitized by Google

Rutidosis helichrysoides, *DeCandolle.*
Myriocephalus Stuartii, *Bentham.*
Calocephalus platycephalus, *Bentham.*
Senecio Gregorii, *F. v. M.* Now known also from the Murrumbidgee and Lachlan River (*F. v. M.*), Mount Murchison (*Bonney*), Spencer's Gulf (*Lattorf*), Paroo (*L. Morton*), Alberga and Lake Eyre (*Giles*), Eyre's Creek (*Kayser*), Finke River (*R. Warburton*), Pidinga (*Mrs. Richards*), Oldea (*Tietkens*), Gascoyne River (*Hon. J. Forrest*).
Senecio lautus, *A. Richard.*
Isotoma petræa, *F. v. M.*
Brunonia australis, *Smith.*
Velleya connata, *F. v. M.*
Scævola ovalifolia, *R. Brown.*
Erythræa australis, *R. Brown.*
Cynanchum floribundum, *R. Brown.*
Ipomœa Muelleri, Bentham.
Evolvulus linifolius, *Linné.*
Nicotiana suaveolens, *Lehmann.*
Duboisia Hopwoodii, *F. v. M.* The famous Pituri bush, found also near Eucla by Mr. J. Oliver.
Mimulus gracilis, *R. Brown.*
Mimulus prostratus, *Bentham.*
Pollichia Zeilanica, *F. v. M.*
Mentha australis, *R. Brown.*
Teucrium racemosum, *R. Brown.*
Eremophila maculata, *F. v. M.*
Eremophila bignoniflora, *F. v. M.*
Eremophila Macdonnellii, *F. v. M.* A red-flowering variety.
Triraphis mollis, *R. Brown.*
Erianthus fulvus, *Kunth.*
Eragrostis concinna, *Stendel.*
Marsilea quadrifolia, *Linné.* The variety *hirsuta* as well as the form *erosa.*

ADDITIONAL LICHENS AND FUNGI OF SOUTH AUSTRALIA, COLLECTED BY J. G. O. TEPPER, F.L.S., 1880 TO 1885.

These were remitted to Baron Sir Ferd. von Mueller, K.C.M.G., &c., the eminent Government Botanist of Victoria, who most courteously submitted them to European specialists of note for identification, and sent me the list of names, being addenda to previous contributions.

LICHENS.

Cladonia squamata, *Hoffmann.* Coast of St. Vincent Gulf, 1883.
Cladonia capitellata, *Babington.* Kangaroo Island, 1884.

Digitized by Google

Parmelia revoluta, *Floerke*. Yorke's Peninsula.
Physcia stellaris, *Nylander*. Yorke's Peninsula, 1880.
" tribacnia, *Nylander*. Clarendon, 1882.
Thelaschistes chrysophthalmus, *Th. Fries*. Yorke's Peninsula, 1880.
Usnea barbata, *Acharius*. Yorke's Peninsula, 1880.
Ramalina geniculata, *Taylor*. Yorke's Peninsula, 1880.
" fraxinea, *Acharius*. Yorke's Peninsula, 1880.
" calicaris, *Acharius*. Yorke's Peninsula, 1880.
Lecidea enteroleuca, *Acharius*. Yorke's Peninsula, 1880.

FUNGI.

Peziza badia, *Persoon*. Clarendon, 1882.
" cochleata, *Bulliard*. Clarendon, 1882.
" fumerata, *Cooke*. Clarendon, 1882.
Agaricus cassiæcolor, *Berkeley*. Clarendon, 1882.
Polyporus pelliculosus, *Berkeley*. Clarendon, 1882.
The Fungi were named by Dr. Cooke, through Baron Sir F. von Mueller, May 31, 1886.

LICHENS NEW FOR SOUTH AUSTRALIA, EXAMINED BY DR. JEAN MUELLER.

Ramalina Eckloni, *Nylander*. Eucla (*Batt*).
" geniculata, *Taylor*. Eucla (*Batt*).
Parmelia hypoxantha. Eucla (*Batt*).
Pertusaria punctulata, *Duby*. Yorke's Peninsula (*Tepper*).

EXCERPT FROM THE THIRD AND FOURTH SUPPLEMENTS OF BARON VON MUELLER'S SYSTEMATIC CENSUS OF AUSTRALIAN VASCULAR PLANTS, GIVING THE SPECIES ADDITIONAL TO THE FLORA OF EXTRATROPIC SOUTH AUSTRALIA.

[Third Supplement.]

Tribulus macrocarpus, *F. v. M.* Towards the tropic near the Queensland Boundary (*Winnecke*).
Sida platycalyx, *F. v. M.* As above.
Sida lepida, *F. v. M.* As above.
Phyllanthus thesioides, *Bentham*. Finke River (*Rev. H. Kempe*).
Casuarina humilis, *Otto and Dietrich*. Eucla (*Batt*).
Dodonæa tenuifolia, *Lindley*. Near Barrier Ranges.
Bassia Cornishiana, *F. v. M.* Field River (*Cornish*).
Gomphrena lanata, *R. Brown*. Finke River (*Rev. H. Kempe*).
Pultenæa scabra, *R. Brown*. Kangaroo Island (*Tepper*).
Crotalaria Mitchelli, *Bentham* (*Tate*).
Ptychosema trifoliolatum, *F. v. M.* Near Barrier Ranges.
Neptunia monosperma, *F. v. M.* Finke River (*Rev. H. Kempe*).

Digitized by Google

Melaleuca quadrifaria, *F. v. M.* Eucla (*Batt*).
Acacia Whanii, *F. v. M.* Near Bordertown (*Winnecke*).
Acacia stipuligera, *F. v. M.* Subtropic region (*Rev. H. Kempe*).
Acacia gonophylla, *Bentham.* Near Eucla (*Batt*),
Hydrocotyle pterocarpa, *F. v. M.* Near the Glenelg River.
Spermacocce marginata, *Bentham.* Near the tropic of Capricorn towards the Queensland boundary (*Winnecke*).
Pluchea tetrandra, *F. v. M.* Near MacDonnell Ranges (*Rev. H. Kempe*).
Gnaphalium Indicum, *Linné.* As above.
Calocephalus Dittrichii, *F. v. M.* Charlotte Waters (*Dittrich*).
Calogyne Bernardiana, *F. v. M.* Near the Finke River (*Rev. H. Kempe*).
Goodenia Strangfordi, *F. v. M.* As above.
Cuscuta Tasmanica, *Engelmann.* Near Bordertown.
Peplidium humifusum, *Delile.* Finke River (*Kempe*).
Utricularia lateriflora, *R. Brown.* Near the Glenelg River.
Eremophila denticulata, *F. v. M.* Near Eucla (*Batt*).
Acianthus caudatus, *R. Brown.* Kangaroo Island (*Tepper*).
Thelymitra luteo-ciliata, *Fitzgerald.* Near Mount Lofty (*Fitzgerald*).
Crinum angustifolium, *R. Brown.* Near MacDonnell Ranges.
Triodia Mitchelli, *Bentham.* Near Barrier Ranges.

[Fourth Supplement.]

Comesperma silvestre, *Lindley.* Near Barrier Ranges.
Stackhousia muricata, *Lindley.* Gosse's Range (*Rev. J. Schwartz*).
Portulaca australis, *Endlisher.* In the subtropic region towards the Queensland boundary (*Lieut. Dittrich*).
Nematophyllum Hookeri, *F. v. M.* As above.
Æschynomene Indica, *Linne.* As above.
Acacia coriacea, *DeCandolle.* Cooper's Creek (*Rev. J. Flierl*).
Lhotzkya Smeatoniana, *F. v. M.* Kangaroo Island (*Tepper*).
Eucalyptus Oldfieldii, *F. v. M.* Near Finke River (*Rev. H. Kempe*).
Hydrocotyle comosa, *F. v. M.* Kangaroo Island (*Tepper*).
Hydrocotyle diantha, *De Condolle.* Kangaroo Island (*Tepper*).
Actinotus Schwartzii, *F. v. M.* MacDonnell Ranges (*Rev. J. Schwartz*).
Hakea chordophylla, *F. v. M.* Subtropic region near Queensland boundary (*Lieut. Dittrich*).
Hakea nitida, *R. Br.* Eucla (*Batt*).
Podolepis rhytidochlamys, *F. v. M.* Near the Barrier Ranges.
Helipterum læve, *Bentham.* Near the Barrier Ranges.
Ceratogyne obionoides, *Turczaninow.* Near the Barrier Ranges.

Digitized by Google

Erechtites picridioides, *Turcz.* Murray River (*F. v. M.*)
Candollea Tepperiana, *F. v. M.* Kangaroo Island (*Tepper*).
Catosperma Muelleri, *Bentham.* Near MacDonnell Ranges (*Lieut. Dittrich*).
Styphelia hirsuta, *F. v. M.* Kangaroo Island (*Tepper*).
Logania stenophlla, *F. v. M.* Close to Eucla (*G. R. Turner*).
Templetonia Muelleri, *Bentham.* On the Western Borders of Victoria.

ADDITIONS TO THE ENTOMOLOGICAL FAUNA OF SOUTH AUSTRALIA.

I. Revision of Australian Lepidoptera. Part 1. By E. Meyrick, Proc. Lin. Soc., N.S. Wales, second series, vol. I., part 3, p. 687, *et seq.*

FAMILY ARCTIADÆ.

7. Scoliacma bicolor, *Boisd.* (Lithosia); L. rubratra, *Tepper.*
18. Brunia replana, *Lw.*
20. Lithosia bicosta, *Walk.*
44. Sorocostia semograpta, *Meyrick.*
47. Sorocostia vetustella, *Walk.*
50. Sorocostia cycota, *Meyrick.*
54. Nola lugens, *Walk.*
69. Hestiarcha pyrrhopa, *Meyrick.*
72. Thallarcha albicollis, *Feld.*
95. Areas marginata, *Don.*
97. Deiopeia pulchella, *L.*

FAMILY HYPSIDÆ.

98. Nyctemera amica, *White.*

FAMILY ZYGÆNIDÆ.

146. Hestiochora tricolor, *Walk.*
148. Procris dolens, *Walk.*
155. Procris viridipulverulenta, *Guér.*
156. Procris cuprea, *Walk.*

II. The Genus Liparetrus. By. W. Macleay. P.L. Soc., op. cit., p. 807, et seq.

1. L. phœnicopterus, *Germ.;* 5. L. Germari, *Macleay;* 7. L. villosicollis, *Macleay;* 10. L. nigrinus, *Germ.;* 11. L. ater, *Macleay;* 14. L. comatus, *Macl.;* 15. L. nitidipennis, *Macl.;* 20. L. Kreusleræ, *Macl.;* 21. L. atratus, *Burm.;* 22. L. iridipennis, *Germ.;* 27. L. bituberculatus, *Macl.;* 31. L. discipennis, *Guér.;* 35. L. canescens, *Macl.;* 45. L. rugosus, *Macl.;* 46. L. collaris, *Macl.;* 48. L. criniger, *Macl.;* 49. L. salebrosus, *Macl.;* 67. L. rotundipennis,

Digitized by Google

Macl.; 68. L. convexior, *Macl.*; 69. L. picipennis, *Germ.*; 70. L. obscurus, *Macl.*; 71. L. nitidior, *Macl.*; 74. L. vestitus, *Blanch.*; 75. L. nudipennis, *Germ.*; 76. L. squamiger, *Macl.*; 79. L. abnormalis, *Macl.*; 80. L. simillimus, *Macl.*; 81. L. Kennedyi, *Macl.*; 95. L. ordinatus, *Macl.*

III. A Revision of the Australian Staphylinidæ. Part II. By H. Sidney Olliff. P.L.S. op. cit., p. 887, et seq.

97. Conosoma phoxum, *Olliff*; 98. C. ambiguum, *Olliff*; 100. C. eximium, *Olliff*.

R.T.

New Australian Freshwater Entomostraca, by Professor G. S. Brady, Proc. Zool. Soc., London, Feb. 2, 1886.

The paper is prefaced by a list of all the Australian freshwater Entomostraca which have been described. The list gives the names and references of eight Phyllopods, nineteen of Cladocera, five of Copepoda, and fifteen of Ostracoda.

The species now described and figured are of Phyllopoda four and of Ostracoda seven, whilst four previously described are now illustrated for the first time.

The South Australian species were collected by Professor R. Tate, and have been named as follows:—*Limnetis Tatei*, Rivoli Bay; *Estheria lutraria*, Cooper Creek, at Innaminka; *Estheria Packardi*, Lake Bonney, River Murray; also Fowler's Bay; *Eulimnadia Rivolensis*, Rivoli Bay; *Cypris Tatei*, Adelaide; *Cypris mytiloides*, Kangaroo Island; *Chlamydotheca australis*, Penola.

Lepidurus viridulus, Tate, Port Creek, is figured.

Remarks on an Unusual Development of a Low Vegetable Organism.

Whilst passing between the city and North Adelaide on the morning of Friday, October 1st, 1886, I observed that the asphalt pavement presented a somewhat peculiar appearance. The weather was warm and calm, and a steady rain had been falling for about two hours. The wet asphalt was thickly dotted with slimy patches of a brownish colour, ranging in size from minute points to the circumference of a dinner plate. A little of the glary substance was gathered, and having been mixed with chloral in a phial, it was at once apparent that the colour of the mass was the result of a large number of small cellular bodies of a brownish tinge, which found support in the otherwise colourless slime. Under the microscope the cells

Digitized by Google

were shown to be an elongated-oval in shape, and with the exception of a very thin film of transparent substance bordering the periphery, the cell was filled with a brown granular mass. The cells were arranged end to end in a somewhat peculiar manner. At first sight the arrangement seemed to be that of a long spiral, but on closer inspection it was recognised that the circle of the spiral was not made complete, but that the line of cells just before completing the circle, at each turn, returned upon itself, so that on one side of the column the spiral looked perfect, but on the opposite side there was a slit extending the whole length of the column, bordered on either side by the rounded loops and intervening open spaces caused by the line of cells returning upon itself instead of completing the circuit. I believe each cell to have been disconnected from the others in the line of growth, although the majority seemed to be just at the touching point. I possessed no means of identifying this curious organism (if already known to science), but judge it may be one of the unicellular confervæ. The weather for some time previously had been very dry. Rain commenced about 6 a.m., and by 8 a.m. the confervoid (?) spores had attained an enormous development. The rain ceasing shortly afterwards, and the sun being warm, the pavement quickly dried, and the slimy patches were left as only dirty stains. The morning following was also wet, but the lowly organisms manifested but a very feeble vitality, and all traces of them quickly passed away. My observations did not extend beyond the distance covered from Government House to the Children's Hospital (about three-quarters of a mile), and cannot say whether they were present in the city or beyond the point in North Adelaide to which I traced them. Their distribution over this length was moderately even, but around the walls and gateposts of the Children's Hospital the patches were unusually large. The warm, humid conditions of the morning were no doubt specially favourable for the rapid increase of the species in question, but the sudden appearance of the form in such incalculable numbers, where their presence had never been suspected, is a somewhat curious phenomenon.

WALTER HOWCHIN.

Digitized by Google

ABSTRACT OF PROCEEDINGS

OF THE

Royal Society of South Australia,

FOR 1885-86.

ORDINARY MEETING, NOVEMBER 10, 1885.

H. C. MAIS, M.I.C.E., in the chair.

BALLOT.—T. S. Reed was elected a Fellow.

W. L. CLELAND, M.B., read some notes drawing attention to the existence of polished rock-surfaces on the top of Caroona Hill, Lake Eyre.

H. T. WHITTELL, M.D., drew attention to and described a telescopic eye-piece for the microscope to correct imperfections in the illumination of objects.

ORDINARY MEETING, DECEMBER 1, 1885.

H. C. MAIS, M.I.C.E., in the chair.

BALLOT.—J. T. Mitchell, M.D., was elected a Fellow.

Paper by Mr. R. B. LUCAS upon "The British Standards of Weights and Measures."

ORDINARY MEETING, FEBRUARY 2, 1886.

H. C. MAIS, M.I.C.E., in the chair.

Mr. J. G. O. Tepper was transferred to the list of Fellows from the list of Corresponding Members.

J. G. O. TEPPER, F.L.S., exhibited a number of insects and insect-habitations. Also preparations of the codlin moth and its larva, found at Unley.

FRAZER S. CRAWFORD reported that he had found a species of *Tortrix*, which had attacked some apple trees near Port Adelaide. The larva was about an inch and a-half long, but was marked differently from that of the codlin moth, by having spots of an ovoid form on the sides.

W. ERNEST COOKE, B.A., read a paper entitled "Notes on the Planet 'Jupiter.'"

Digitized by Google

ORDINARY MEETING, MARCH 2, 1886.

W. HOWCHIN, F.G.S., in the chair.

BALLOT.—A. Zietz and D. Fleming were elected Fellows.

CLEMENT L. WRAGGE, F.R.G.S., read "Scientific Results of the Voyage of the S.S. Maranoa."

ORDINARY MEETING, APRIL 6, 1886.

W. HOWCHIN, F.G.S., in the chair.

BALLOT.—W. B. Poole and James L. Scott were elected Fellows.

J. G. O. TEPPER, F.L.S., exhibited a number of *Mantidæ* and *Phasmidæ*. Also a species of *Acantholophus* found on *Xanthorrhœa Tatei*, Kangaroo Island. Also a species of weevil (*Chrysolophus*), black with a white line. Also the core, sections, resin, and leaf-basis of *Xanthorrhœa Tatei* from Kangaroo Island.

Prof. RENNIE read a paper upon "Poisoning by Tinned Foods."

ORDINARY MEETING, MAY 4, 1886.

W. RUTT, C.E., in the chair.

BALLOT.—Prof. Bragg was elected a Fellow, and the Rev. C. G. Nicholay a Corresponding Member.

A. ZIETZ showed a series of fishes belonging to South Australian waters.

F. A. PULLEINE showed specimens of *Migerlia Williamshousii* and *Limopsis Tenison-Woodsii* from Encounter Bay.

J. G. O. TEPPER, F.L.S., read a paper on "Aerial Boats; suggestions as to the principles of construction, and the obstacles to be surmounted."

ORDINARY MEETING, JUNE 1, 1886.

W. HOWCHIN, F.G.S., in the chair.

FRAZER S. CRAWFORD showed some olives from near the Adelaide Gaol which had been attacked by *Aspidiotus Nerii*.

He also corrected an error made by the Hon. P. L. Van der Byl, of Cape Colony, in giving evidence before the Commission on Vegetable Products in Melbourne, in which he stated that *Saria Purchasii* had been seen in South Australia on the *Acacia armata*. The coccus found upon these plants was in reality yet undetermined, but he would provisionally name it *Erinum globosum*. *Saria Purchasii* was not common now, although abundant at the Cape.

Digitized by Google

A. ZIETZ exhibited a number of lizards of one species, but varying very much in colours and markings.

R. B. LUCAS read a paper upon "Photometry," with some illustrations.

ORDINARY MEETING, JULY 6, 1886.

H. C. MAIS, M.I.C.E., in the chair.

BALLOT.—John Wilson, F.E.I.P., was elected a Fellow.

A. ZIETZ showed specimens of *Trachinina*, common in the River Murray, and many creeks along the coast.

J. G. O. TEPPER, F.L.S., read "Notes on some S.A. Trogidæ."

J. G. O. TEPPER, F.L.S., exhibited a specimen of *Agyris amaryllis*, from Yorke Peninsula. Also some wood fossilised, obtained at Echunga from a depth of 60 feet.

G. GOYDER, JUN., read "Notes upon the Determination of Gold in Minute Quantities in Ores."

WALTER HOWCHIN, F.G.S., read the results of his investigations respecting the Foraminifera in the Tarkinnina and Mirrabuchinna bores.

ORDINARY MEETING, AUGUST 3, 1886.

W. HOWCHIN, F.G.S., in the chair.

BALLOT.—A. P. Vaughan, M.B., was elected a Fellow.

H. T. WHITTELL, M.D., exhibited the results of some experiments he had made with vaccine lymph.

"Notes upon some New Fresh-water Entomostraca," by Prof. G. S. BRADY, were read; illustrated by specimens obtained by Prof. R. Tate from Rivoli Bay, Cooper's Creek, Lake Bonney, Fowler's Bay, Kangaroo Island, and Penola.

WALTER HOWCHIN, F.G.S., showed a number of geological specimens from Crystal Brook, and pointed out the errors that miners might avoid if they only possessed a little more scientific knowledge of geology.

J. G. O. TEPPER, F.L.S., brought forward some *Phasmidæ*—one probably new and undescribed.

A. ZIETZ showed a large collection of stone implements belonging to the Museum.

ORDINARY MEETING, SEPTEMBER 7, 1886.

WALTER HOWCHIN, F.G.S., in the chair.

AUDITOR—L. C. E. Gee was appointed Auditor of the Hon. Treasurer's accounts.

THOMAS PARKER, C.E., showed a sandstone with "ripple marks" from Betaloo.

Digitized by Google

J. G. O. Tepper, F.L.S., exhibited *Callitris Muelleri* from near the Murray Bridge.

A. Zietz showed a coccus (*Dorthesia*), also a specimen of *Lipidurus* and a species *Typhlops*.

J. Phillips forwarded geological specimens containing organic remains from near Hergott.

J. G. O. Tepper submitted lists and descriptions of newly-recorded plants from Kangaroo Island.

Baron F. von Mueller forwarded a paper on "*Corchorus Elderii*."

Gavin Scoular sent a paper descriptive of the "Physical Features and Geology of the District about Lake Eyre."

Annual Meeting, October 5, 1886.

H. C. Mais, C.E., in the chair.

Walter Howchin, F.G.S., showed samples of gelatinous masses, the result of confervoid growth, found by him on the asphalt pavement on King William road.

A note from Baron F. von Mueller respecting two additions to the flora of South Australia was read.

The annual report and balance-sheet were read and adopted.

Election of Officers.—Professor Rennie as President; Walter Howchin, F.G.S., and R. L. Mestayer, F.R.M.S., as Vice-Presidents; Walter Rutt, C.E., as Hon. Treasurer; W. L. Cleland, M.B., as Hon. Secretary; as members of Council, H. T. Whittell, M.D., Charles Todd, C.M.G., M.A., D. B. Adamson, J. W. Bussell, Prof. Bragg, J. Davies Thomas, M.D.

J. G. O. Tepper, F.L.S., suggested some alteration of rules, which were referred to the Council.

The President read his annual address (see p. 228).

Gavan Scoular forwarded a paper respecting Prof. Tate's objections regarding his paper on "Past Climatic Changes," &c.

Prof. Tate forwarded papers relating to the Palliobranchs, Lamellibranchs, Pteropods, and Scaphopods, with descriptions of some new Mollusca for South Australia.

Prof. Tate sent a description of *Caladenia cardiochila*, with a drawing by J. G. O. Tepper.

Prof. John Brazier forwarded a paper on the "Trochidæ of South Australia, with their Synonyms; part I."

E. Guest forwarded paper upon the "Geometrina Found Round Balhannah."

Digitized by Google

ANNUAL REPORT.

The Council has to report that the work of the Society has been successfully carried on during the past year. The following papers have been read or laid on the table:—"References to some Polished Rock Surfaces on Caroona Hill, Lake Gilles," by Dr. Cleland; "Description of a Telescopic Eyepiece for the Microscope," by Dr. Whittell; "The British Standards of Weights and Measures," by R. B. Lucas; "Notes of a large Sawfish found at Carnavan, W.A.," by Geo. Sarter; "Notes on some Insects and Insect Nests," by J. G. O. Tepper, F.L.S.; "Notes on a Species of Tortrix," by Frazer S. Crawford; "Observations on the Planet Jupiter," by W. Ernest Cooke, B.A.; "Scientific Results of the Voyage of s.s. Maranoa in the Indian Ocean," by Clement L. Wragge, F.R.G.S.; "Notes on the Mantidæ and Phasmidæ," by J. G. O. Tepper, F.L.S.; "Poisoning by Tinned Foods," by Professor Rennie; "On Aerial Boats," by J. G. O. Tepper, F.L.S.; "Photometry," by R. B. Lucas; "Notes on some South Australian Trogidæ," by J. G. O. Tepper, F.L.S.; "Notes on a New Butterfly for South Australia—*Ogyris amarillis*," by J. G. O. Tepper, F.L.S.; "On the Determination of Minute Quantities of Gold," by G. Goyder, jun.; "On some Foraminifera found in the Tarkininna and Mirrabuchinna Bores," by W. Howchin, F.G.S.; "On the Cultivation of Vaccine Lymph," by Dr. Whittell; "Some Fresh-water Entomostraca," by Prof. G. S. Brady; "Some Geological Notes on the neighbourhood of Crystal Brook," by W. Howchin, F.G.S.; "On some Phasmidæ," by J. G. O. Tepper, F.L.S.; "Some newly-recorded Species of the Flora of Kangaroo Island," by J. G. O. Tepper, F.L.S.; "Notes on *Corchorus Elderii*," by Baron F. v. Muller; "The Geology of the South and South-Western portion around Lake Eyre," by Gavin Scoular; "Notes on a New Species of *Caladenia*," by Professor Tate, F.G.S., &c.; "A Revision of the Recent Lamellibranch and Palliobranch Mollusca of South Australia," by Prof. Tate; "Notes on Past Climatic Changes in South Australia," by Gavin Scoular; "The Geometrina found near Balhannah," by E. Guest.

The exhibits have been numerous and varied, although nothing has been brought forward requiring special notice.

The membership of the Society consists of 117 Fellows, 11

Digitized by Google

Hon. Fellows, 14 Corresponding members, and two Associates. Several names, to the number of 16, have had to be removed from the roll on account of deaths and other causes. Nine new Fellows have been elected, and one Corresponding Member—the Rev. C. G. Nicholay, of Western Australia.

During the past year another Section of the Royal Society has been formed, namely, the Microscopical Section. It already includes many leading members of the Parent Society, as well as other independent workers; and under the guidance of its first chairman (Dr. Whittell) it has made considerable progress, and promises to be a valuable auxiliary.

The reports and balance-sheets of the two Sections appear satisfactory, and speak for themselves and of the particular work that they are respectively accomplishing.

It having been felt that the many valuable books of the Royal Society of South Australia were in their present position quite useless to the Fellows generally, your Council has proposed to the Board of Governors of the Public Library to allow a certain space for them in the Public Library, so that they may be easily accessible to the Fellows. This proposal has been favourably entertained by the Board, and it only requires the duplicates to be weeded out for the proposal to become an accomplished fact. It is hoped that this alteration may prove of benefit to the Fellows.

During the past year the Society has continued to receive a number of European and American and colonial periodicals on scientific matters generally. The Council has had a number of completed volumes bound, in order that they may be the better preserved. Amongst other books may be specially mentioned the receipt of additional numbers of the "Geological and Natural History Survey of Canada and the United States," "Report of the recent Volcanic Eruptions in New Zealand," "A Classified Index of Naturalised and Indigenous Plants of Queensland," and also a "Synopsis of the Queensland Flora," by F. M. Bailey; "Descriptions of Papuan Plants," by Baron F. v. Mueller; and by the same author, "On the Extratropical Plants of Australia."

A recommendation was made to the Board of Governors of the Museum by the Council, at the suggestion of the Field Naturalists' Section, with respect to the formation of a collection illustrative of the economic entomology of South Australia. The Board expressed its sense of the importance of the matter and willingness to co-operate as far as their limited space would allow, if the Fellows would furnish the material.

The Council has been communicated with in respect to the holding of a Centenary Science Association in Sydney in 1888, and has, on behalf of the Fellows, expressed its willingness to do

Digitized by Google

its best to represent South Australian science. The Council has also asked Mr. Russell, the Astronomer-Royal of Sydney and an Honorary Fellow of this Society, to represent this Society at the preliminary meetings. This he has very kindly promised to do, and the Society may congratulate itself on having secured so able a representative.

As in the previous year, the Council has authorised the preparation of a large number of plates illustrating some of the mollusca, and which are now being prepared under the valuable guidance of Prof. Tate. The results, as seen in the last volume of the Society's Proceedings, will cause the scientific world to look forward with a lively interest to a further instalment of Prof. Tate's scientific labours on this important branch of natural history.

Digitized by Google

PRESIDENT'S ADDRESS.

By H. C. Mais, M.I.C.E., read at the Annual Meeting, October 5, 1886.

I propose to touch upon various subjects with which most of us are familiar, and to take a retrospect of the advancement made during the past year. Confining myself more particularly to engineering achievements, the magnitude of the progress effected in engineering within recent times makes it impossible to present even an abridgment of the subject to the Society, involving as it would an exhaustive research into all the records of the various countries where the art is practised.

Engineering is, as Telford aptly describes it, "*the art of directing the great sources of power in nature for the use and convenience of man*," and you will at once perceive the vastness of the field in which the science of engineering is being practised. Amongst the foremost of engineering works of the day bridges and tunnels may be mentioned, and some very important bridges are in course of construction in England, America, and elsewhere. At the present time the most important structures now in progress in England are the Forth and Tay Bridges; in America, the Susquehanna River Bridge, the Henderson Bridge, and the John's River Bridge; in Canada, the Lachine Bridge; in India, the Sukkar Bridge across the Indus; and last, but not the least in magnitude, is the Hawkesbury Bridge in New South Wales. I do not propose to do more than briefly describe these structures, which are among the largest yet erected.

BRIDGES.

FORTH BRIDGE.

The Forth Bridge crosses the Forth at Queensferry, and was designed by Messrs. Fowler & Baker, C.E.s. The work was commenced by Messrs. Tancred & Arrol in January, 1883, and consists of two spans of 1,700 feet each, two of 675 feet, fourteen of 168 feet, and six of 50 feet. There is about a mile of main spans and half a-mile of viaduct approach. The clear headway is 150 feet above the water, and the top of the girder of the great cantilevers is 350 feet above high water. There will be 45,000 tons of steel used in superstructure, and 120,000 cubic yards of masonry in the piers. The contract price was £1,600,000. One peculiar feature in the design is that the bridge is constructed from its south abutment for a length of eleven spans of 147½ feet each as an ordinary double line of railway. The two lines of rails then diverge gradually, one on

Digitized by Google

each side of the centre line, by reverse forty-chain curves, for a distance equal to one span of 144 feet, two spans of 176 feet, and one of 176½ feet, at which point it reaches the Queensferry tower, and attains a width apart of 100 feet, forming two distinct lines of railway. It then runs parallel at this distance apart for the length of the two 1,700-feet spans for the four towers, and for the two spans between the towers of 165 feet each. The lines will gradually converge by reverse forty-chain curves, and regain the form of an ordinary double line of rails as far as the north abutment.

TAY BRIDGE.

The Tay Bridge is now being erected to supersede the bridge that collapsed during the gale in 1877. The new bridge was designed by Mr. W. H. Barlow, C.E., of London, and consists of 85 spans, being a total length of 10,515 feet, or nearly two miles. There are four brick arches and thirteen spans over navigation (eleven of them being 245 feet each and two of them 227 feet each), the two latter being 28 feet 9 inches deep. The piers are of wrought-iron, supported on iron cylinders sunk 20 feet into the river bed, and filled with concrete and brickwork. The height of the under members of the girders above high water is 77 feet. The contractors are Arrol & Co., of Glasgow, and the cost will be £700,000.

SUSQUEHANNA BRIDGE.

The Susquehanna Bridge is on the Baltimore and Ohio River, and is 6,315 feet long, having four spans of 480 feet, and one span of 520 feet.

HENDERSON BRIDGE.

The Henderson Bridge is also across the Ohio River, in Kentucky, U.S.A., is 3,200 feet long, with one channel span of 725 feet; the remaining spans are 250 feet each. It is 103½ feet above low water, and 57 feet above high water. The approach is by trestle work three miles in length, and the cost has been £372,000.

ST. JOHN'S BRIDGE.

The St. John's Bridge is a cantilever bridge 447 feet between the piers. It is built across the river before it enters the Bay of Fundy, and at a point where it is contracted between two rocky ledges to a width of about 500 feet. The tide rises and falls about 22 feet, producing violent currents, so that a cantilever bridge was the most feasible structure. The rail level is 75 feet above tide. The erection of this bridge occupied 90 days, and the structure is capable of carrying a moving load of one and a quarter tons, and a wind pressure of 40 pounds per superficial foot. It was designed by Mr. Abbot, and built by

Digitized by Google

the Dominion Bridge Company at Quebec. The total cost was £110,000.

LACHINE BRIDGE.

The Lachine Bridge is on the Canadian Pacific Railway, and has 20 spans of 242 feet. They are simple truss girders, carrying the rails on the top, except on the two channel spans, where the rails run between the girders. The cost is £250,000.

SUKKAR BRIDGE.

The Sukkar Bridge is built across the Indus and has a cantilever span of 790 feet in the clear, the clear centre span being 200 feet; the height of the cantilever is 40 feet, and it is supported with trussed iron guys 280 and 300 feet long respectively. The width of the members at the bed-plates is 100 feet, and at the cantilever ends and centre of back guys 20 feet wide. It is built of steel, and for a single track, and will weigh, exclusive of the clear centre 200 feet span, 3,000 tons. It was designed by Mr. Rendel and built by Westwood, Bailie, & Co., of Poplar, England. I am unable to state the cost, but the coffer dams cost £1,635, and the erection of the ironwork £4,354.

HAWKESBURY BRIDGE.

The Hawkesbury Bridge is to be built across the River Hawkesbury, in New South Wales, near its discharge into Broken Bay. It is to be 2,896 feet long, in five spans of 416 feet each and two spans of 408 feet each. The width will be 28 feet centre to centre of trusses. The total height from the bottom of the piers to the rail level will be 227 feet, the rail level being 42 feet above high water; the piers have to be sunk 185 feet. The sinking of the piers, which will be of wrought iron filled with cement concrete up to low-water level, will be watched with much interest. The piers are all oval in shape, being 20 feet wide and 48 feet long, of three-eighths inch boiler plate. Within this large tube three cylindrical tubes will be placed, and joined to the outer shell by bell-mouthed connections. These inner tubes are to be used for dredging the contents of the large tube, and by this means allowing it to sink to the required depth. The contract price for delivery and erection is £327,000, and the work is let to the Union Bridge Company, of New York, and a large portion of the ironwork is being executed in Glasgow.

IRON AND STEEL.

The question of Bridge construction leads me to touch upon the relative values of iron and steel for such purposes. In looking at these values, I find that in a paper read in August, 1885, Mr. Jeremiah Head, the President of the Inst. Mech.

Digitized by Google

Engineers, supplies the following reasons why steel made according to Lloyd's requirements is superior to iron for ship-building.

1st. It is very much more ductile.

2nd. It is equally ductile in both directions of the grain.

3rd. It has 30 per cent. more tensile strength in the direction of the grain.

4th. It has 50 per cent. more across the grain.

5th. Its elastic limit is 21 per cent. more in either direction of the grain.

He goes on to point out a curious and important fact, though little known, that the elastic limit in iron plates is equal in both directions, as it is in steel, although the ultimate strength and ductility are inferior in the cross direction.

It seems clear that mild steel has much less practical advantage over wrought iron when used for bridges and roofs than when used for ships.

STEEL FOR BRIDGES.

The great advantage gained by the use of steel for bridges and other similar work is its high elastic limit as compared with its weight, and in all large spans this is an important element, as the weight of the span is the principal cause of the strain, but, notwithstanding this, English engineers are slow to introduce steel very largely into general use, as wrought iron is still more used than steel in bridges and roofs and for agricultural implements.

RAILS, TYRES.

Closely connected with the use of steel for bridge and roof building is its application to rails, tyres, axles, &c. The use of steel rails is now almost universal, and they can be produced at a lower rate per ton than wrought iron rails. They are usually made by the Bessemer or Siemen's process, and are found to be infinitely superior in wear and tear to wrought iron. They should be tough, and yet not brittle under traffic, and able to stand the breaking and crushing effects produced by the locomotive wheels. Mr. Price Williams, a recognised authority, states that a steel rail will outlast nine iron rails under the same conditions of traffic, and it may be accepted as a fact beyond dispute that it will at least last double the time.

It is chiefly on account of the great resistance of steel to abrasion that this material has superseded iron for railway wheel tyres, but where such a quality is not absolutely essential, such as in ordinary works where bars, angles, and plates are used, and in bridges, roofs, and ships, iron is as good as steel, and steel is only used in consequence of its superior elastic limit in proportion to its weight. With regard to the application of

Digitized by Google

steel for axles of railway engines and rolling stock, experience has shown that this material is not altogether trustworthy, and the returns of the Board of Trade show that steel axles are not so reliable as iron.

During the year 1884, 385 axles failed on the English railways, killing 24 and injuring 75 passengers, and out of the 385 axles that failed 200 were locomotive crank axles, and the average mileage of iron crank axles for the same year was 216,333 miles, and of steel 173,287 miles, but the breakage of steel axles is not confined to crank axles, which are essentially of a weak form to resist the varying strains to which they are subjected, for numerous instances of the breakage of carriage and waggon axles have occurred, and are occurring, and I do not doubt that we shall eventually return to iron as the best material for railway axles.

TUNNELLING.

Tunnelling is executed with much greater dispatch now than formerly, in consequence of the introduction of rock drills driven by air or water, the use of better explosive compounds, and better system of ventilation.

The most recent examples of large tunnels completed are those under the Mersey at Liverpool, and under the Severn.

MERSEY TUNNEL.

The Mersey Tunnel, connecting Liverpool with Birkenhead, is 3,820 yards long, and is carried under the bed of the river, which is 1,320 yards in width. It is constructed for a double line of rails. It leaves the Central Station in Liverpool and joins the Central Station at Birkenhead, the distance being about two miles. The tunnel is 26 feet wide and 19 feet high, and is lined with brick-work, set in cement. It is ventilated with four "Guibal" fans, which work in separate air passages, 7′ 4″ diameter, cut through the rock and connected with the tunnel. There are two underground stations—one at Hamilton-square, the other at James-street, and being about 80 feet below the street level, are approached by an inclined subway and hydraulic lift 18 feet square, capable of seating 100 passengers. The underground portion of these stations is hewn from solid rock, and is 400 feet long, 50 feet wide, and 30 feet high. The traffic amounts to over 26,000,000 of passengers and 750,000 tons of goods per annum. The engineers were Mr. James Brunlees, with whom was associated Mr. Chas. D. Fox. The tunnel was formally opened to the public by H.R.H. the Prince of Wales on January 20th, 1886, and occupied six years in its execution. The length of the railway is three miles, and the cost has been £1,000,000.

Digitized by Google

SEVERN TUNNEL.

The Severn Tunnel is the largest work of the kind ever carried out in England. It passes under the river about half a mile below the railway ferry, and is 7,942 yards long, of which 3,960, or two and a-quarter miles, are under the bed of the river. The depth of water over the line of tunnel at high water is 96 feet, and at low water 60 feet. It is lined with brickwork in cement, the brickwork varying from 1 foot 10½ inches to 3 feet in thickness. The total cost is estimated at £1,500,000.

CASCADE TUNNEL.

The Cascade Tunnel on the Northern Pacific Railway has been commenced, and will be 9,880 feet long.

Tunnels have been projected under Mont Blanc and the Simplon, each being about twelve miles in length, but it is feared that after the experience of the St. Gothard Tunnel the heat in the centre of the tunnel would make it impossible for human beings to live in the atmosphere.

The great Dover Straits scheme has collapsed for a time, and it is much to be regretted that a work which seems so practicable should be deferred.

SUBMARINE BLASTING.

Regarding the removing of large masses of rock by tunnelling and blasting, we have an excellent example in the recent successful removal of Flood Rock in Hell Gate, New York Harbour, in October last year. By this one blast 200,000 cubic yards of rock were so disrupted as to render its removal by dredging an easy operation. The area of the work was nine acres, and 225,000 pounds of giant gunpowder and 75,000 pounds of dynamite were used on this occasion.

WATER SUPPLY.

Water supply is in this country at all events a very important subject for discussion, and I do not propose to discuss this question now, leaving it for those who have specially interested themselves in the subject to deal with it at some future time, my present intention being only to allude to the two great water schemes now in progress, viz., those in Liverpool and New York.

VYRNWY DAM.

The Vyrnwy Dam, from which it is proposed to supply the town of Liverpool, is to be built of masonry, and is to be 136 feet high in the centre, 1,258 feet long, and 117 feet thick in its greatest width, impounding 1,118 acres of water, from which an aqueduct 35 miles in length will convey the water to the town.

Digitized by Google

NEW YORK.

The works in New York are intended to supply 320 millions of gallons of water daily to the city. The works consist of a masonry dam 178 feet high, 1,300 feet long, and impounding 3,200 millions of gallons. The masonry dam has to be sunk 100 feet to reach rock foundation, so that its total height will be nearly 300 feet, and its bottom width 200 feet. The water will be conveyed by an aqueduct with its diameter averaging twelve feet, and will be 31 miles long to the Central Park Reservoir. The aqueduct crosses the Harlem River by means of a syphon 156 feet below the surface of the river.

RAILWAYS.

Some interesting information has been compiled in a paper read before the American Society of Civil Engineers, "English and American Railroads compared," by Mr. B. Dorsey. He states that in 1883 there were in England 18,681 miles of railway, costing over £40,000 per mile, and at the same date there were completed in America 110,414 miles, costing on an aver-average £12,400 per mile; the operating expenses of the English lines being £2,000, and of the American, £880 per mile. The ton mileage of the English was 9,589,786,848 and of the American 44,064,923,445, and passenger mileage 5,494,801,496 and 8,817,684,503 respectively.

Assuming that the above statements are correct, considerable allowance must be made for the difference in the value of the land traversed by the railways in the two countries, and, although the cost of floating railway companies in America is great—amounting in some instances to £2,000 to £3,000 per mile—yet when you value the different conditions under which the work is carried out in the two countries, there is no doubt that railways can be and are made more economically in America than in England, and a perusal of an excellent paper written by Mr. Robert Gordon before the Institution of Civil Engineers will throw much additional information upon the subject. This paper is "On the Economical Construction and Operation of Railways in countries where small returns are expected, as exemplified by America." This subject, although of great interest to us as colonists, would occupy too much time to enter into on the present occasion, but I will briefly refer to one or two points mentioned in the above paper.

The author attributes one of the great and essential features in the American as compared with English practice to the adoption of types capable of automatic reproduction in identical forms where practicable. In one case alone, the whole railway system of America will shortly be of one universal gauge of

Digitized by Google

4 feet 8½ inches, and I think it worth while recording the fact that between May 31st and June 3rd of this year the gauge of 11,500 miles of railway was changed to the standard with scarcely any impediment to traffic.

Up to the present time the only standard article accepted is the freight-car axle, and it is expected shortly that a standard size of wheel and shape of tyre will be agreed to. One important feature in the shape of the tyres likely to be introduced and adopted is that the portion under ordinary circumstances in contact with the rail shall be cylindrical for a width of two inches, and the remainder coned as usual for use when running round curves.

It is customary in the United States, where timber is comparatively cheap and good ballast scarce, to use a larger number of sleepers per mile and a less quantity of ballast than usual; but there is a decided determination among the leading American engineers not to use light rails either for narrow gauge or so-called light railways. Economy is to be sought for elsewhere than in either rolling-stock or permanent way. The principal economy is, therefore, to be found in the first cost of laying out and grading the line. It is interesting to note the results accruing from attempts to avoid heavy gradients by increasing the magnitude and cost of the earth and other works. Some of the Main Trunk Lines cross the ranges at very high levels, notably the Baltimore and Ohio line, which crosses the Appala chain range at an elevation of 2,706 feet by grades of 1 in 45 eleven miles long on one side, and seventeen miles long on the other, with curves of 600 feet radius.

The Pennsylvania Railway originally crossed the same range at an elevation of 2,160 feet with the gradients of 1 in 37 and 1 in 49, but these grades have been much improved since that time. The Erie Railway was originally most carefully laid out to get over a summit of 1,374 feet, and heavy expenses, amounting to £44,000 per mile, were incurred in obtaining a maximum grade of 1 in 88.

The New York Central has maximum grades of 1 in 56, with sharp curves; and its rival — the West Shore line — has a low summit level, with grades of 1 in 264 and 1 in 176, but the cost has been so great that it is feared the line will have to be absorbed by its rival, the New York Central. On all economical railways of the standard gauge moderately steep grades have been successfully adopted. The largest private company in the States, or in the world, is the Chicago, Milwaukee, and St. Paul. It owns and operates 5,000 miles of line.

The plan adopted in the United States is to locate the line carefully in the first instance, with the view to subsequent

Digitized by Google

improvements as traffic develops; and to this end the use of steep grades, the free use of curves and wooden structures are largely availed of—wood being used because it is plentiful, and is the cheapest and handiest material procurable. As the revenue of the country becomes larger and the business of the railway develops, the lines are improved, the grades lowered, the curves made larger, and permanent structures introduced. Whenever 40 per cent. of the gross earnings will pay the interest on the funded debt, the balance, after deducting operating expenses, is expended in making improvements. The rails are now all of steel—about 67 lbs. to the yard for trunk lines, 60 lbs. to the yard for minor lines; sleepers never less than 2,800 per mile. The average life of the timber bridges is nine to eleven years.

Mr. Gordon, from whose paper I have quoted largely, winds up with the following observations:—

I. There is no difference in the principles underlying the American practice in the location of light railways and that of the most expensive and perfect railways for heavy traffic, and that while the former is looked upon as an imperfect stage of development of the latter, due consideration is usually given and provision made for the growth and improvement of the line to a better condition as the traffic increases, with the least possible fundamental alteration in the line and its belongings. The highest engineering skill is as much, if not more, required in laying out a cheap and light as a heavy line.

II. The latest and best American practice rejects the use of light rails and permanent way for an economical railway. It must be prepared for the ordinary passenger and freight cars of the country to pass over, the only difference being that light loads would be carried on the lighter line at lower speeds. To fix these ideas without attaching precise value to figures, it might be expressed by saying that whilst 3,000 pounds per lineal foot of train appears to be the maximum load of a freight train on a heavy road at the present time, 2,000 pounds per lineal foot is a limit for a light railway, and the bridge-work should be calculated for these loads. Steel rails not less than 55 pounds per yard, and sleepers not less than 2,800 to the mile, with 15,000 super feet of bearing surface, should be used.

III. Some advocate light engines and frequent trains; others prefer heavier engines and fewer trains, with greater loads. In the Far West, where only one or two trains run each way per diem, the heaviest engines are frequently used, with trains loaded to the utmost.

IV. When no extra cost is incurred the same grades and curves that would be given to the best railway the country ad-

Digitized by Google

mits of should be used for the economical one. In the ordinary rough country the usual curvature is about 573 feet (or less than ten chains) radius, with gradients properly compensated—in fact, the practice was to use the best curves that the topographical nature of the country allowed. To use the words of Mr. Wellington, an eminent American engineer:—

"Roughly speaking, and excluding curves in stations, one-half of American mileage might be said to be built to a radius of 1,900 to 1,430 feet; half the remainder to 955 feet; half the remainder to not over 573 feet, and only about one-eighth to sharper radii, the standard maximum being 359 feet radius, which brought the cost in the roughest country within reasonable limits, and enormously below what twice the radius rendered possible; whilst on the other hand using any sharper radii than that best adapted to the given topographical conditions rarely saved more than an inconsiderable percentage."

Terminal and station facilities should be of the cheapest description, and level crossings should be used everywhere, and fencing dispensed with except in cattle-grazing districts.

The question to be solved in America and in all new countries is, "Shall we construct a cheap railway or have none at all?" This was essentially the case in Queensland, and it practically was the reason for the introduction into that country of 3′ 6″ or narrow gauge as it is termed. In America narrow gauge lines are not now built, and every year sees the change from the narrow to the standard gauge, 4′ 8½″, which is now being carried out at a very heavy cost, but the break of gauge has become so troublesome that the various Companies are only too desirous to adopt the standard. The best American practice was not a wasteful employment of heavy grades for the sake of saving distance and eliminating curves, but it was to get as low grades as possible for the longest portion of the distance, and to concentrate the heavy grades together and work them with extra engine power.

One important element should not be forgotten when we speak of the cheap system of railway construction adopted in America, and that is the country is generally well supplied with timber and water, thereby materially cheapening the construction.

ABT SYSTEM.

During the past year a very satisfactory system has been invented by Mr. Abt, of Switzerland, for overcoming mountain inclines. This problem has taxed the brains of many inventors, but the plan devised by Mr. Abt appears destined to supersede all others. He has abandoned the well-know rack rail with its two sides and rollers acting as teeth between them, and builds up a number of elementary racks, and places them side by side.

Digitized by Google

Each one of the elementary parts is nothing more than a rack in its simplest form, or a bar of iron or steel provided with teeth. Whatever may be the tractive power to be developed by the pinion working in the rack, by placing side by side the proper number of bars, each one is strained only to its chosen limit. The bars are connected by chairs and bolts, by which they are secured to the road bed. The bars are laid with broken joints, so that the teeth of one bar are slightly in advance of those in another. The pinion is similarly constructed of discs, and are stepped to suit the teeth in the rack. The discs have elastic springs of rubber between them and the shaft to which they are fixed, thus admitting of adjustment to any imperfection in the accurate manufacture of the racks. This works so well that at a speed of sixteen miles an hour there is no noise or blow whatever.

One characteristic feature in the system is the adaptation of the rack to the steepness of the gradient, the number or thickness of the elementary bars being chosen according to the traction required. Curves can also be easily traversed, which is not the case with the ordinary rack rail. This system has been most successfully used on the Hertz Railway, Prussia, and is being applied to the Höllenthal Railway, South Germany, and on the extensive slate quarries connected with the Bavarian State railways.

SHIP RAILWAYS.

An American engineer of some celebrity (Captain Eads) has conceived the idea of transporting ships overland by means of railways, and although considerable opposition has been offered to the scheme by engineers, it has been approved by Congress.

It seems to me a very difficult problem to solve, bearing in mind the enormous weight of the vessels now built, including their machinery and cargo, and it is difficult to conceive how the very large number of wheels required to carry this load without straining the ship can be moved over rails unless they are laid on an unyielding foundation with mathematical accuracy. The locomotive power to move such a mass would also be very great.

There is, however, a ship railway now under way from the Gulf of St. Lawrence to the bay of Fundy, and another is projected across the Florida Peninsula.

PANAMA CANAL.

Among the great works in progress may be mentioned the canal across the Isthmus of Panama. Grave doubts are expressed by many eminent American engineers as to the possibility, or rather the probability, of the successful completion of this great undertaking. Great faith is placed by the

Digitized by Google

French people in M. Lesseps' ability to carry out his scheme. In fact, his name exercises a spell over the majority of Frenchmen, who are looking forward with implicit confidence to the time when this great highway shall be opened.

It is more than 300 years ago since this project was first brought into notice by a Portuguese navigator (Antonio Galvao), and varying attempts have been made to carry out the undertaking. The great difficulty to be encountered will be in dealing with the valley of the Chagres River, which is known to be subjected to heavy and practically uncontrollable floods, which rise to a height of 40 feet in 24 hours. It is intended that this shall be a sea-level canal, but it is not improbable that if it is ever built at all it will be made with locks.

BALTIC CANAL.

Another scheme for a ship canal is that contemplated between the Baltic and North Seas, as well as the

MANCHESTER SHIP CANAL,

for which a charter has been obtained from the British Parliament, but from the latest advices there appears to be some difficulty in floating the latter scheme, owing to the opposition of the Railway Companies interested.

RECENT ATLANTIC STEAMERS.

The transition from ship canals to steamships is an easy one, and as a mark of the recent progress made in marine engineering as applied to transatlantic steamships I would refer briefly to the record of the steamship America, built for a British Company by Messrs. Thomson, the well-known Clydebank builders. This vessel is really an innovation in transatlantic voyaging, and was designed to steam through the water at the rate of 18 to 19 knots an hour continuously, and has proved equal to the tests imposed, not only in regard to her speed, but likewise in her consumption of fuel, as she burns only 180 to 190 tons of coal per diem when steaming at the above speeds, whereas the usual consumption of similar steamers at a much reduced speed is from 300 to 350 tons of coals per diem. She is built on the principles laid down by the late Mr. Froude, viz., that a comparatively short and broad vessel with a fine entrance and run aft, carried on continuous curving lines, could be driven through the water at a higher velocity than a long and narrow vessel of the same capacity, but with fine entrance and parallel sides.

The s.s. America is 459 feet long, 51 feet wide, and 38½ feet deep amidships. Her tonnage is 8,830, and carrying capacity 2,830 tons; her engines are 7,000 horse power, and at 66 revolutions give a speed in smooth water of 18 knots, and with

Digitized by Google

70 revolutions a speed of 19 knots, on a coal consumption of 180 tons per day. She carries 670 cabin and 300 second-class passengers, whose quarters are abaft the engines, which have one high-pressure cylinder 63 inches diameter, and two low-pressure, each 91 inches diameter and 66 inches stroke. The steam enters the cylinder at 90 lbs. per square inch. The time occupied in steaming from Liverpool to New York has been reduced from about eight days six hours to six days twelve hours.

ELECTRICITY.

Electricity seems destined to work great wonders, and tends to develop, if not to solve, the great problem of transportation. It has already been successfully applied to the working of tramways, and I do not think that the day is far distant when it will be employed in many instances to supersede steam in propelling steamships and drawing railway trains. Immense progress has been made during the past twelve months in developing the application of electricity to street-railway transit, especially on the Continent of Europe. It is only recently that the application of electric and magnetic currents has been extensively used in some of the larger cities, and the electric motor, as now perfected, certainly justifies the belief that it will be the motive power in the future. Professor Thompson has asserted as his opinion that electrical energy used for the transmission of power has a far greater future before it than its transformation into light. Professor Ayrton also is confident of the future use of electricity as a motive power for our railways which will combine speed, economy, and safety, and entirely abolish smoke and other inconveniences. The "Daft" motor, the Antwerp tramway tests, the Siemens and Holske electric locomotive, and several American machines of like nature show that the electric railway is gaining upon its rival the steam railway.

ANTWERP.

At Antwerp five motors were tested—three propelled by direct steam action, and two by direct stored-up force supplied by a fixed engine. After a trial of four months' duration the first prize was awarded to the electrical motor driven by accumulators, which consisted of Faure batteries, from which the car was also lighted at night with incandescent lamps. The car weighed 5,654 lbs., the accumulators weighing 2,400 lbs.; the weight of the machinery, including the dynamo, was 1,232 lbs., and carried about 34 passengers.

Electricity has been also employed for colliery purposes—the locomotives carrying their own storage of current, consisting of a series of accumulators, whose weight was usefully em-

Digitized by Google

ployed in increasing the adhesion of the car-wheels to the rails.

BESSBROOK, NEWRY.

At the Bessbrook spinning works, Newry, Ireland, there is an electric tram running having a capacity for 34 passengers. The trams surmount grades of 1 in 85 at a speed of seven miles an hour easily. The motive power is supplied by a turbine wheel, the conductor being an inserted steel channel laid on insulators between the rails.

SIEMENS AND HOLSKE.

The Siemens and Holske electric railway from the Military Academy at Berlin to Potsdam, eight miles distant, is in successful operation on an ordinary railway, insulated wheel tyres being used to take off the current.

BLACKPOOL.

An electric tramway has been installed at Blackpool, England. The electrical portion of this line is placed beneath the surface of the street, and the rails are not used as in the previous case at Berlin, but the conductor consists of two copper elliptical tubes having a wide slot for attachment to iron studs supported upon porcelain insulators, fixed to creosoted blocks of wood. The tubes are attached to the studs by wooden wedge pins. This line is working very satisfactorily.

ECONOMY OF ELECTRICITY AS A MOTIVE POWER.

As an economical agent for propulsion it is claimed for electricity that when used as a motor every pair of wheels can be utilised for pulling or retarding. That by a suitable proportion in the speed of the generator to that of the electro motors 70 per cent. of the effect given out by the generators can be utilised.

It has also been demonstrated that a power equal to that developed by one horse can be obtained from an electro motor for every 50 lbs. dead weight of car.

It is also claimed that when the rails are used as a medium through which the electric current passes there is no chance of accident from a broken rail, as the current would be either broken or so much attenuated as to cause a stoppage of the motor. Each horsepower of effective energy developed by the stationary engine that supplies the power will produce in the electro motor an effective energy equal to one-half horsepower.

The motion communicated to the electro motor being circular and not reciprocating as in an ordinary steam engine, it is claimed that all shocks and jars are avoided, and the maintenance of the motive machinery, permanent way, bridges, &c.,

Digitized by Google

are materially reduced, so that eventually greatly increased speed will be possible with complete safety.

NORTH METROPOLITAN.

A new electrical engine of the North Metropolitan Tramway Company, Stratford, England, solves the problem of economical working by combining electrical power with the aid of the mechanical application of the lever. The engine consumes only two tons of coals per week, and will charge batteries sufficient to do the work of four cars, requiring 44 horses per week.

A curious fact connected with the development of the electro motor occurred in Paris during the Exhibition in that city in 1878, when one of the workmen engaged in fixing the dynamo by a mistake connected together the wires of the Gramme dynamos, with the result that the electricity from one dynamo caused the shaft of the other to revolve rapidly. This blunder gave to the world the principle of the power of reversing the dynamo, and formed the germ of the electrical railway.

WORKING RAILWAYS BY AID OF ELECTRICITY.

Without the aid of electricity the working of the railway system of the present day with safety would be almost if not quite impossible.

BLOCK WORKING.

By its means the block working of trains is carried on, and it is now almost impossible to have what are known as "rear collisions" on double lines where the system is in use.

LOCKING SIGNALS BY ELECTRICITY.

One system that came under my notice when travelling in England was the application of electricity to lock the starting signals from one station to another by making the train itself perform the duties necessary for completing the signals, and restoring the electrical current for setting a second signal. By this means a signalman cannot lower his train-starting signal to allow it to proceed to the next station until the signalman at the station in advance has in reply to an arranged bell code unlocked the signal lever. The electric lock having been taken off enables the signalman to lower the signal, and on putting it to danger again after the departure of the train to protect it he cannot lower it again for a second train to follow on the same line until the lock is removed by the signalman at the station in advance, and he is unable to take off this lock until the first train has passed a certain point fixed by the railway authorities. When the train passes this point the apparatus in the signalman's box in the rear is re-set by the action of the train itself, the weight of which deflects the rail and makes contact whereby the apparatus is re-set for the next following

Digitized by Google

train. By this system the men at each end of a section cannot make a mistake, and the men themselves are controlled by the action of the train itself until it is clear of the section.

TABLET SYSTEM.

There is a very ingenious electrical apparatus used for working single lines of railway, which works most admirably. It consists of a box containing tablets, and is fixed at each end of a section of the railway—say at every station. It is necessary that the driver of the train should have one of these tablets given to him before he can leave the station at which he is standing. The tablet is given by the stationmaster to the guard, and by him to the engine-driver, so that both may know they have the necessary authority to start. But before the stationmaster can remove one of these tablets from the box containing them he must first communicate with the station in advance, when the stationmaster there, if the line is clear, releases one of the tablets by sending an electric current through for the purpose; and before another tablet can be taken from the box at either station for a train to proceed in either direction the tablet in the possession of the engine-driver of the train occupying the section must be previously placed in the box at the station in advance on its arrival there, thereby rendering a mistake almost impossible.

ELECTRIC LIGHTING.

When in America I noticed with much interest the plan of electric lighting adopted in some of the cities. It consisted of mounting the light or lights upon a tall mast, or framework of iron. If it is required to light a square, it is accomplished by erecting a tall mast in the centre, and having a ring of arc or other lamps fitted to it, and a very good and sufficient light is thereby obtained. If it is required to light the intersection of two thoroughfares, then a light iron framework springing from each curb and uniting at the top where the lights are attached. This forms an excellent method of lighting. The London and South-Western Railway Company of England have adopted the high-mast system for lighting their goods-yard at Nine Elms, and it answers admirably, facilitating, as it does, the marshalling of trains, and preventing to a considerable extent the practice of thieving from the waggons and sheds.

Time will not permit me to refer to many other subjects of great interest, such as the nature and use of

NATURAL GAS,

as found in Pennsylvania. It is used for domestic as well as for manufacturing purposes, iron, steel, and glass factories using it instead of coal. It also, when imperfectly burned,

Digitized by Google

deposits carbon of considerable density, and sufficiently good to be used for the purposes of the electric light. It absorbs and carries off oil and grease when used under pressure, and is employed for cleansing delicate fabrics. It produces superior glass to that obtained by fusion with coals, and covered pots for this purpose are found to be unnecessary.

Before concluding I would like to refer to the progress made in

MILITARY ENGINEERING WITH REGARD TO ARMOUR-PLATE AND WEAPONS.

Great progress has been made during the past few years in this direction, and shields, cupolas, &c., are now made from chilled cast-iron as well as of steel.

CHILLED CAST-IRON ARMOUR PLATE.

The Gruson chilled cast-iron armour plate, which lately withstood most successfully three shots from the 16-inch 100-ton gun at Spezzia, has just successfully resisted a fourth shot, although it struck the plate at a point where it had been weakened by previous shots. This experiment has yielded the best results on record of any armour-plate up to the present time.

The experiments made in the improvements in construction of torpedoes still continue, and the perfection to which these dangerous weapons are now brought is marvellous; they can be steered in any direction, and manœuvred with the greatest ease. Nitro-glycerine has also been successfully used in filling shells for destructive purposes; but one of the most successful machines lately introduced has been the Maxim gun.

MAXIM GUN.

This gun is automatic, and is the invention of Mr. Hiram Maxim, of London, and it differs very materially in its action from the machine guns generally adopted. The first mechanical gun of any practical value was invented by an American, Dr. Gatling, in 1863, and they were used extensively during the American War in 1865. Subsequently another American—Mr. Hotchkiss—invented a machine gun, and took his invention to France, where these guns are extensively manufactured. The Nordenfelt and the Gardner guns followed in rotation. All these guns require manual labour in loading, firing, and discharging the empty shells. They also have magazines for the ammunition holding from a dozen to 100 cartridges. The workmanship in these guns, to be reliable, must be of the very best, and the great fault found with them in action is their liability to jam or hang fire.

The Maxim gun, which I propose to shortly explain, is

Digitized by Google

entirely automatic, and the chief feature is that the recoil is used for loading and firing. The gun is about 4 feet 9 inches long, and stands on a tripod 3 feet 6 inches high. The cartridges are placed in a canvas belt made in two lengths, rivetted together at regular intervals so as to form loops, into which the cartridges are first inserted by hand. In order to keep up continuous firing a fresh belt is hooked on to the end of the one that is running, and no delay ensues. A water-jacket encircles the barrel, which prevents the excessive heating caused by the rapid discharge. To fire the gun all that is necessary is to turn a handle, which brings the first cartridge into the barrel. On pulling the trigger the first cartridge explodes and the empty shell is expelled from the breech, which instantly receives a fresh cartridge from the magazine, which is pressed firmly home by the breech-block closing and locking the breech completely during the explosion; and it cannot be unlocked again until the barrel, which participates in the recoil, has moved backwards about seven-sixteenths of an inch. By this time the shot is some distance out of the barrel, and the pressure of the gases is sufficiently reduced to render it safe to open the breech. The barrel still recoils, and while it is stopping the breech-block, with its attachments, is sent further backwards, thereby removing the empty shell and cocking the hammer. The return or forward travel of the block pushes another cartridge into the barrel, closes the breech, and pulls the trigger, and so on. On pulling the trigger by hand, the first shot is fired; the gun will then supply itself from the belt, and continue firing as long as there are any cartridges in the belt. For naval purposes larger guns are made, to take shells 1¼ inch diameter and 6 inches long, and will fire 150 shots a minute. A six-pounder, capable of piercing four inches of steel plate, will fire 50 shots a minute.

HEAVY GUNS.

Forging guns from steel is carried on on a large scale both in England and on the Continent. Herr Krupp, the owner of the extensive steel works at Essen, has just completed two giant guns intended for the defence of Pola, in the Adriatic Sea. The length of each cannon is 34·1 feet, the diameter at the bottom 4·75 feet, and at the mouth 2 feet. The transport of these guns from Essen to Pola will cost £300. They will be carried on sixteen-wheel trucks specially constructed, and weighing 39 tons, and having a carrying capacity of 75 tons.

I fear I have trespassed too long upon your patience this evening, my difficulty being to know when to stop my address, having left untouched so many subjects of general interest. I hope, however, that during the coming session some of our

Digitized by Google

members will find leisure to give us papers on electricity, water supply, and water conservation, as applied to this colony in particular, the influence of tree-planting as regards rainfall and climate, sanitary engineering, the possibility of the application of irrigation in this colony with water obtained from artesian borings, &c., and other subjects of importance to us as colonists.

Digitized by Google

THE TREASURER IN ACCOUNT WITH THE ROYAL SOCIETY OF SOUTH AUSTRALIA.

Dr.	£ s. d.	£ s. d.	Cr.	£ s. d.	£ s. d.
October 1st, 1885.			By Cost of Transactions—		
To Balance brought forward		367 2 2	Printing and Binding	82 2 2	
" Subscriptions—			Illustrating	13 15 0	
Royal Society	92 2 6		Publishing	5 5 11	
Field Naturalists' Section ..	25 0 0				101 3 1
Microscopical Section	11 2 6		" Salaries, &c.—		
		128 5 0	Assistant Secretary	21 0 0	
" Government Grant—			Attendant	1 9 0	
1884-5 (second instalment) ..	28 15 2				22 9 0
1885-6	54 12 9		" Advertising		8 1 6
		83 7 11	" Printing, Postage, and Stationery ..		19 4 10
" Interest—Savings Bank		9 7 6	" Library—Binding		17 3 6
			" Field Naturalists' Section—		
			Grant	20 0 0	
			Printing and Stationery	5 1 6	
					25 1 6
			" Microscopical Section—		
			Grant	11 0 0	
			Advertising	0 17 6	
					11 17 6
			" Balance—		
			Bank of South Australia	128 14 2	
			Savings Bank	259 7 6	
					388 1 8
		£588 2 7			£588 2 7

Audited and found correct,

LIONEL C. E. GEE, Auditor.

October 5th, 1886.

WALTER RUTT, Treasurer.

Digitized by Google

DONATIONS TO THE LIBRARY

For the Year 1885-6.

I.—Transactions, Journals, and Reports.

Presented by the respective Societies, Editors, and Governments.

Baltimore, U.S.A.—American Chemical Journal, vol. VI., No. 5, 6; vol. VII., No. 1, 3, 4, 5.

——— Johns Hopkins' University Circulars, vol. IV., No. 36, 38, 40, 42; vol. V., No. 43, 45.

——— Johns Hopkins' University Studies in Historical and Political Science; Third Series, I., II., III., IV., V., VI., VII., IX., X., XI., XII.

——— Ninth Annual Report of the President of the Johns Hopkins' University, 1884.

——— Proceedings of the Trustees of the John F. Slater Fund for the Education of Freedmen, 1883, 1884.

——— Memoirs of the National Academy of Sciences, vol. III., part 1.

Batavia—Natuurkundig Tijdschrift voor Nederlandsch-Indië, utgegeven door de Koninklijke Natuurkundige Vereeniging in Nederlandsch-Indië, Deel XLV.; Achtste Serie, Deel VI.

Belfast—Report and Proceedings of the Belfast Natural History and Philosophical Society for 1884-5.

Berlin—Sitzungberichte der königlich-Preussischen Akademie der Wissenschaften zu Berlin; Nos. 40 to 44, 1884; 1885, 1 to 39, 40 to 52.

Bombay—Journal of the Bombay Natural History Society, vol. I., No. 2, 3.

Bonn—Verhandlungen des naturhistorischen Vereines der Preussischen Rheinlande und Westfalens; 1882 (one part), 1883 (two parts), 1884 (two parts). Do., 1883 and 1884.

Boston—Proceedings of the Boston Society of Natural History, vol. XXIII., part 1, 4.

Digitized by Google

———Memoirs of the Boston Society of Natural History, vol. III., No. XI.

———Proceedings of the American Academy of Arts and Sciences; New Series, vol. XII.; whole Series, vol. XX.

Cambridge, U.S.A.—Bulletin of the Museum of Comparative Zoology at Harvard College, vol. XII., Nos. 2, 3, 4, 5.

——————— Twelfth Annual Report of the Curator of the Museum of Comparative Zoology at Harvard College, 1884-5.

——————— Bulletins, Nos. 2, 3, 4, 6, 7, 8, 11.

Canada—Proceedings of the Canadian Institute, Toronto; Third Series, vol. III., No. 143.

——— Summary Report of the Operations of the Geological and Natural History Survey of Canada, part 3.

Cape Town—Transactions of the South African Philosophical Society, vol. III., part 2.

Colorado, U.S.A.—Proceedings of the Colorado Scientific Society, vol. I., 1883-4.

Dublin—Scientific Transactions of the Royal Dublin Society, vol. III., series 2, parts 7 (duplicate), 8, 9, and 10.

——— Scientific Proceedings of the Royal Dublin Society, vol. IV., New Series, parts 7, 8, 9; vol. V., parts 1, 2.

Edinburgh—Proceedings of the Royal Physical Society, vol. VIII., part 2.

Göttingen—Nachrichter von der Konigl. Gesellschaft der Wissenschaften und der Georg. Augusts. Universität zu Gottingen, Aus dem Jahre, 1884; Nro. 1-13.

Greensburg, Pa., U.S.A.—From Frank Cowan, "Australia: A Charcoal Sketch."

Lausanne—Bulletin de la Société Vandoise des Sciences Naturelles 2e S; vol. XXI., No. 92-93.

Leicester—Provincial Medical Journal; vol. V., No. 49, 55.

London—Journal of the Royal Microscopical Society; Series II., vol. V., Parts 5, 6,; and vol. VI., Parts, 1, 2, 3, 4.

——— Transactions of the Entomological Society of London for 1885.

Mexico—Annario del Observatorio Astronomico Nacional de Tacubaya para el Ano de 1886. Formido bajo la Direction del Ingeniero Angel Anguiano. Ano VI.

——— Antropologia Mexicana. El Hombre del Peñon.

Digitized by Google

Noticia Sobre el Hallazgo de un Hombre Prehistorico en el Valle de México. From Mariano Barcena.

Manchester—Report and Proceedings of the Manchester Field Naturalists' and Archæologists' Society for 1885.

———— Journal of the Manchester Geographical Society, 1885. Vol. I., Nos. 1, 2, 3.

Montreal—Geological and Natural History Survey of Canada. Contributions to Canadian Palæontology. Vol. I.

Munchen—Sitzungberichte der Mathematish-Physikalischen Classe der K. B. Akademie der Wissenschaften zu Munchen. 1884, Heft 2, 3, 4; 1885, Heft 1, 2, 3.

———— Abhandlungen der Mathematisch-physikalischen Classe der Königlich-Bayerischen Akademie der Wissenschaften Fünfzehten Bandes, Zweite abtheilung. In der Reihe denkschriften der LII., Band. 1885.

New South Wales—Australian Museum. Report of the Trustees for year 1884.

———— Catalogue of the Echinodermata in the Australian Museum. By E. P. Ramsay, F.R.S.E., &c. Presented by the Trustees.

———— Proceedings of the Linnean Society of New South Wales. Vol. X., parts 3, 4.

Do., do., New Series. Vol. I., parts 1, 2.

———— Descriptive Catalogue, with Notes, of the General Collection of Minerals in the Australian Museum. By Felix Ratte. Published by order of the Trustees.

———— Royal Society of New South Wales. President's Address, 5th May, 1886. By the author.

———— Royal Society of New South Wales. Results of Rain and River Observations made in New South Wales during 1885. By H. C. Russell, B.A., &c.

———— Local Variations and Vibrations of the Earth's Surface. By H. C. Russell, B.A., F.R.A.S., &c.

———— Catalogue of the Library of the Linnean Society of New South Wales.

———— Sydney University Calendar, 1886.

Digitized by Google

———— Australian Museum. Report of the Trustees for 1885.

———— Annual Report of the Department of Mines for 1886.

New York—Annals of the New York Academy of Sciences, vol. II., No. 8.

———— Transactions of the New York Academy of Sciences, vol. III., 1883-4 and 1885-6.

New Zealand (from Colonial Museum of New Zealand, James Hector, Director)—Handbook of New Zealand; fourth edition.

———— New Zealand Court, Indian and Colonial Exhibition, 1886.

———— The Recent Volcanic Eruptions.

Philadelphia, U.S.A.—Proceedings of the Academy of Natural Sciences of Philadelphia, part II., of 1885.

Queensland—Classified Index to the First Supplement to the Indigenous and Naturalised Plants of Queensland; F. Manson Bailey, F.L.S.

———— Queensland Woods: Catalogue of the Indigenous Woods contained in the Queensland Court, Colonial and Indian Exhibition of 1886; F. M. Bailey, F.L.S.

———— A Synopsis of the Queensland Flora, containing both the Phænogamous and Cryptogamous Plants; Fredk. Manson Bailey, F.G.S., Colonial Botanist.

Salem, Massachusetts—Bulletin of the Essex Institute, vol. 15, complete; vol. 16, complete.

———— Peabody Academy of Science. Eighteenth Annual Report.

South Australia—Report of the Geological Character of Barossa and Para Wirra. H. Y. L. Brown, F.G.S., &c., Government Geologist.

———— Report on the Fusicladiums, &c., by Frazer S. Crawford. Presented by the Government of South Australia

Tasmania—Papers ordered by the Legislature to be printed.

———— Royal Society of Tasmania. Abstract of Proceedings, July 13, 1886, August 10, 1886.

Turin—Bollettino dei Musei di Zoologia ed Anatomia comparata della R. Universita di Torino, vol. I., Nos. 1 to 8.

Victoria—Australasian Statistics for 1884, with Report.

———— Observations of the Southern Nebulæ made with

Digitized by Google

the Great Melbourne Telescope from 1869 to 1885; part II.

——— Statistical Register of the Colony of Victoria for 1884; parts V., VI., VII., VIII., IX. Index and Agricultural Statistics.

——— Statistical Register of the Colony of Victoria for 1885; part I., Blue Book; II., Population; III., Finance.

——— The Australasian Scientific Magazine, vol. I., Nos. 3, 4.

——— Victorian Naturalist, vol. II., Nos. 8, 9, 10; vol. III., Nos. 1, 2.

——— Victorian Year-Book, 1884-5; by H. H. Hayter. Three copies.

——— Seventh Annual Report of the Government Statist in connection with Friendly Societies, 1884.

——— The Chemist and Druggist of Australasia, vol. I. No. 4 and No. 5.

——— School of Mines, Ballarat. Annual Report for 1885.

——— Descriptive Notes on Papuan Plants; F. von Mueller; No. VIII.

——— Select Extra-Tropical Plants, 1886 edition; F. von Mueller. Presented by Government of Victoria.

——— Department of Mines, &c., Victoria. Reports of the Mining Registrars for Quarter ended March, 1886.

——— Field Naturalists' Club of Victoria. Sixth Annual Report.

——— Myoporinous Plants of Australia—II., Lithograms; F. von Mueller.

Vienna—Kaiserlich Academie der Wissenschaften in Wien. Sitzung der Mathematisch-naturwissenschaftlichen Classe; Nos. XIX. to XXIV., of 1885, 25 to 27 index and title-page, 1886; No. 1—4, 5, 6, 7, 8, 9, 11, 12, 13, 14, 18.

——— Annalen des K.K. Naturhistorischen Hofmuseums redigirt von Dr. Franz Ritter von Hauer, Jahresbericht, fur 1885; Band I, No. 1.

——— Mittheilungen des Ornithologischen Vereines in Wien; 9 Jahrgang, Nos. 20–32; 10 Jahr., No. 1.

——— Verhandlungen der Kaiserlich-Königlichen Zoologisch-botanischer Gesellschaft in Wien; Jahrgang, 1884 and 1885, Nos. 1 to 15 of 1885; also 17, 18, and No. 1 of 1886.

——— Personen-Ort-und, Sach-Register (1871-1880), der K.K. Zool.-botanischen, Gesellschaft in Wien.

Digitized by Google

Washington—Monographs of the United States Geological Survey, vols. VI., VII., VIII., vols. III., IV., V., and atlas to vol. III.
——— National Academy of Sciences.—Proceedings, vol. I., part 2.
——— National Academy of Science.—Report for 1883.
——— Report for 1884.
——— Third Annual Report of the Bureau of Ethnology, 1881-2.
——— Report of the International Polar Expedition to Point Barrow, Alaska.
——— Annual Report of the Board of Regents of the Smithsonian Institute for 1883.
——— Annual Report of the Comptroller of the Currency. H. M. Cannon.
——— Fourth Annual Report of the United States Geological Survey, 1882-3.
——— Mineral Resources of the United States, 1883-4 (U.S. Geological Survey).
——— Bulletins of the United States Geological Survey; Nos. 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14.
——— Memoirs of the Washington Academy of Sciences, vol. II.
——— United States Geological Survey.—Contributions to American Ethnology, vol. V.
——— Annual Report of the Bureau of Ethnology, 1880-81.
Würzburg—Sitzungberichte der Physicalisch-Medicinischen Gesellschaft zu Würzburg; Jahrgang, 1885.

Digitized by Google

LIST OF FELLOWS, MEMBERS, &c.

NOVEMBER, 1886.

Those marked (F) were present at the first meeting when the Society was founded. Those marked (L) are Life Fellows. Those marked with an asterisk have contributed papers.

		Date of Election.
HONORARY FELLOWS.		
Barkley, Sir Henry, K.C.M.G., K.C.B.	.. .. ..	1857
Ellery, R. L. J., F.R.S.	Melbourne	1876
*Garran, A., LL.D.	Sydney	1853
*Hull, H. M.	Hobart	1855
Jervois, Sir W. F. D., K.C.M.G., C.B.	New Zealand	1878
Little, E.	.. .. ..	1855
Macleay, Hon. W., F.L.S... ..	Sydney	1878
*Mueller, Baron F. von, K.C.M.G., F.R.S.	Melbourne	1879
Russell, H. C., B.A., F.R.A.S. ..	Sydney	1876
Warburton, Col. P. E., C.M.G. ..	Beaumont	1858
*Woods, Rev. J. E. T., F.L.S., F.G.S.	Sydney	1877
CORRESPONDING MEMBERS.		
Bailey, F. M., F.L.S.	Brisbane..	1881
Canham, J.	Stuart's Creek	1880
Chandler, T.	Peake	1881
*Cloud, T. C., F.C.S.	Wallaroo	1881
*East, J. J.	Mallala	1884
*Foelsche, Paul	Palmerston	1882
Goldstein, J. R. Y.	Melbourne	1880
*Hayter, H. H., M.A., C.M.G., F.S.S.	Melbourne	1878
Holtze, Maurice	Palmerston	1882
*Kempe, Rev. J.	Finke	1880
Nicholay, Rev. C. G.	Fremantle, W.A. ..	1886
*Richards, Mrs. A.	Port Augusta	1880
*Scoular, Gavin	Smithfield	1878
*Stirling, James, F.L.S.	Omeo	1883
FELLOWS.		
*Adamson, D. B.	Adelaide	1867
Adcock, D. J.	Adelaide	1887
Angas, J. H.	Angaston	1874
Black, A. B.	Adelaide	1882
Boettger, Otto	Adelaide	1884
Bragg, Prof.	Adelaide	1886
Brown, J. E., F.L.S.	Adelaide	1882
Brown, L. G.	Two Wells	1882
Browne, H. Y. L., F.G.S.	Adelaide	1883
Bruer, J.	Adelaide	1883
Brunskill, Geo.	Morgan	1878
Burchell, F. N.	Adelaide	1881
Bussell, J. W.	Adelaide	1884

Digitized by Google

*Campbell, Hon. Allan, M.L.C., L.R.C.P. Edin.	Adelaide	1882
*Chalwin, Thos., M.R.C.V.S. Eng. ..	Adelaide	1877
Chapple, F., B.A., B.Sc.	Prince Alfred College ..	1876
*Cleland, W. L., M B., Ch.M., F.R.M.S.	Parkside	1879
*(L)Cooke, E.	Adelaide	1876
*Cooke, W. Ernest, B.A.	Adelaide	1885
Cox, W. C.	Semaphore	1880
Cornish, W. H.	Adelaide	1883
*Crawford, F. S.	Adelaide	1865
*Davenport, Sir Samuel	Adelaide	1856
Davies, Edward	Adelaide	1882
Davis, F. W.	Adelaide	1882
Dixon, Samuel	Adelaide	1887
Dobbie, A. W.	Adelaide	1876
Elder, Sir Thomas	Adelaide	1871
Fleming, David	North Adelaide	1886
*Fletcher, Rev. W. R., M.A. ..	Kent Town	1876
Foote, H.	Outalpa	1883
Fowler, W.	Kulpara	1882
Gall, David	North Adelaide	1865
Gardner, Wm., M.D., C.M. ..	Adelaide	1882
Gee, Lionel C. E.	Adelaide	1882
Gill, George	Adelaide	1884
Gill, H. P.	Adelaide	1883
Gill, Thomas	Adelaide	1885
Gosse, John, M.R.C.S.	Wallaroo	1884
*Goyder, Geo., jun.	Adelaide	1880
Grundy, E. B.	Adelaide	1882
*Haacke, Wm., Ph.D.	Adelaide	1882
*Harris, C. H.	Adelaide	1883
Harris, T. W.	Adelaide	1882
Harrold, A. L.	Adelaide	1876
*Haslam, John	Adelaide	1883
Hay, Hon. A., M.L.C.	Adelaide	1861
Henry, A., M.D.	Adelaide	1882
Hopkins, Rev. W.	Adelaide	1880
*Howchin, W., F.G.S.	Goodwood East	1883
Hughes, H. W.	Booyoolie	1883
*Hullett, J. W. H.	Port Augusta	1876
Johnson, J. A.	Adelaide	1875
*Jones, W. E.	Parkside	1885
*(F) Kay, R.	Adelaide	1853
Kelly, Rev. Robert	Mount Barker	1884
Knevett, S.	Adelaide	1878
*Lamb, Prof., M.A., F.R.S.	England	1883
*Laughton, E.	Adelaide	1874
Lendon, A. A., M.D.	Adelaide	1884
*Lloyd, J. S.	Adelaide	1856
*Lucas, R. B.	Adelaide	1885
Magarey, A. T.	North Adelaide	1873
*Magarey, S. J., M.B.	Adelaide	1874
Mais, H. C., M.I.C.E.	Adelaide	1883
*Mayo, Geo., F.R.C.S.	Adelaide	1853
Mayo, G. G.	Adelaide	1874
Mestayer, R. L., F.R.M.S. ..	Adelaide	1883
*Meyrick, E. B.A.	Sydney	1881
Middleton, W. J. E.	Kangarilla	1882

Digitized by Google

Mitchell, J. T., M.D.	Port Adelaide	1885
Molineux, A.	Kent Town	1880
(L) Murray, Hon. David, M.L.C. ..	Adelaide	1859
Munton, H. S.	Adelaide	1884
Nesbitt, W. Peel, M.B.	England	1880
Neale, W. L.	Adelaide	1884
O'Leary, M. P., M.R.C.S.	Port Victor	1884
Parker, Thomas, C.E.	Port Adelaide	1883
Phillips, W. H.	Adelaide	1883
Pickels, W. E., F.R.M.S.	Adelaide	1883
Poole, W. B.	Adelaide	1886
Poulton, B., M.D.	Adelaide	1883
Rigaud, R. J.	Adelaide	1882
Reed, T. S.	Adelaide	1885
Robertson, R., F.F.P.S.	Adelaide	1882
*Rennie, Prof., D.Sc., F.C.S. ..	Adelaide	1885
Renner, F. E., M.D.	Carrieton	1885
Russell, William	Port Adelaide	1879
*Rutt, Walter, C.E.	Adelaide	1866
Salom, Hon. M., M.L.C.	Adelaide	1866
*Schomburgk, R., Ph.D.	Adelaide	1865
Scott, Jas. L.	Hyde Park	1886
*Smeaton, Thos. D.	Mount Barker	1857
Smith, E. Mitchell	Adelaide	1883
Smith, R. Barr	Adelaide	1871
Smyth, C. B.	Adelaide	1884
Smyth, J. T., B.A., B.E.	Norwood	1882
*Stirling, E. C., M.D., F.R.C.S., M.P.	Adelaide	1881
Stuckey, J. J., M.A.	Adelaide	1878
*Tate, Prof. R., F.G.S.	Adelaide	1876
*Thomas, J. D., M.D.	Adelaide	1877
*Tepper, J. G. O., F.L.S.	Norwood	1878
*Todd, Charles, C.M.G., F.R.A.S. ..	Adelaide	1856
Tyas, J. W.	Adelaide	1882
Umbehaum, C.	Adelaide	1879
*Varley, A. K.	Mount Gambier	1883
Vaughan, A. P., M.B.	North Adelaide	1886
*Verco, J. C., M.D.	Adelaide	1878
Vickery, G.	Meadows	1868
Ware, W. L.	Adelaide	1878
Wainwright, E. H., B.Sc.	St. Peter's College ..	1883
Watson, Rev. John	Parkside	1884
Way, E. W., M.B.	Adelaide	1879
Way, S. J., Chief Justice	Adelalde	1859
Wheeler, F.	Adelaide	1884
White, R. A.	Adelaide	1882
Whiting, J. B.	Adelaide	1882
Whittell, H., M.D., F.R.M.S. ..	Adelaide	1882
Wilson, John, F.E.T.S.	Goodwood	1886
*Wragge, C. L., F.R.G.S.	Brisbane	1877
Young, Wm., M.A.	Hindmarsh	1880
Zietz, A.	Adelaide	1886

ASSOCIATES.

Burchell, D.	Adelaide	1883
Hodgson, Mrs.	Port Victor	1884

Digitized by Google

APPENDIX.

PROCEEDINGS
OF THE
Field Naturalists' Society of the Royal Society
1885-86.

OFFICERS 1886-7.

Chairman:
MR. J. G. O. TEPPER, F.L.S.

Vice-Chairmen:
MR. W. L. CLELAND, M.B. REV. J. McEWIN.

Committee:

PROFESSOR R. TATE, F.G.S., F.L.S.	MR. D. J. ADCOCK
MR. S. J. MAGABEY, M.B.	MR. G. G. MAYO
MR. A. MOLINEUX	MR. D. FLEMING
MR. H. DEAN, JUN.	MR. J. R. GURNER.

Hon. Secretary:
MR. W. H. SELWAY, JUN.

EXCURSIONS.

FIRST EXCURSION—MONDAY, NOVEMBER 9, 1885.—ROCKY GULLY (NEAR OAKBANK).

This excursion was made at the suggestion of Mr. W. C. Grasby, head teacher of the public school at Oakbank. That gentleman examined various sites; and the choice at length fell on Rocky Gully, situate some three or four miles to the east of Oakbank, and close to the watershed of the Onkaparinga. To this place between thirty and forty members and friends of the section made an excursion on Monday, November 9, when a start was made by the 9.15 a.m. train. On arrival at the Balhannah station it was found that vehicles were in waiting to convey the party to their destination, the route for a short distance lying along the main road to Woodside. Shortly after passing Oakbank an easterly direction was taken, and soon after the property of Messrs. J. & A. G. Johnston was entered upon. In due course a spot close to Rocky Gully was reached, which seemed to be a convenient halting-place, and was within a

Digitized by Google

stone's throw of the Banksia Gold Mine, the name of the latter having apparently been given on account of the number of honeysuckle-trees (*Banksia marginata*) growing in the neighbourhood. Here luncheon was partaken of, after which Mr. Grasby led the way up the hill at the foot of which they had been camping. They had not proceeded far when Mr. E. Guest, of Balhannah, called attention to an orchid of a peculiar and conspicuous marking, its petals being of a golden colour, thickly covered with reddish-brown spots. This proved to be *Thelymitra fusco-lutea*, a somewhat rare and local species. Ascending the hill *Asperula oligantha* (white), *Hibbertia densiflora* (yellow), *Comesperma calymega* (blue), and that very small green orchid, *Microtis porrifolia*, were gathered, and Mr. Tepper called attention to the sedge, *Cladium filiforme*, as being characteristic of the hill flora. Several varieties of everlastings (*Helichrysum*) were also noticed, these favourite flowers being very plentiful in this part of the country. Two orchids of the genus *Caladenia*, the shrub *Isopogon ceratophyllus*, and the small flowers of *Xerotes nana* were observed, and now by a slight detour the Banksia Mine was reached. After inspecting this attempt at developing our mineral resources a rest was indulged in, after which Mr. Grasby led the party to what he had believed to be some granite rocks about a mile away, but on arrival there they were found to be mica slates. Another short rest and then a line was struck for the camping ground. An easterly direction was subsequently taken, and a moist gully soon reached, where *Stylidium despectum* (or *Candollea despecta*), *Polypompholyx tenella*, *Hydrocotyle callicarpa*, and *Rutidosis pumilo* were collected, while the carnivorous *Drosera auriculata* was perhaps seen to greater advantage here than on any previous excursion. In the bed of an old watercourse were gathered the minute *Ranunculus parviflorus*, and some very pretty fungi. It was now considered time to return to the camp, the route lying through a dense scrub of *Leptospermum myrsinoides*, which had now nearly done flowering. Emerging from this difficult piece of country, in which *Bartlingia sessiliflora* had been met with, more flowers were observed, of which may be mentioned the two orchids *Thelymitra nuda* and *Prasophyllum patens*, and of other flowers, *Euphrasia Brownii* (white), *Cheiranthera linearis* (purple), *Styphelia virgata* (white), and *Brunonia australis*, the last of which was very abundant all about Rocky Gully. About 6 o'clock the party reached the camping ground, and shortly afterwards a start was made on the return journey. Tea was served at the hotel at Balhannah, and votes of thanks were passed to Messrs. J. & A. G. Johnston and Mr. W. C. Grasby. The party returned to town by the 9.30 p.m. train.

Digitized by Google

Second Excursion—Saturday, November 28, 1885.—Montacute.

Between twenty and thirty members and friends started from the Old Exchange, King William-street, in one of Hill and Co.'s coaches shortly after 1.30 p.m., proceeding via the Glynde Hotel to the foot of the Black Hill, just south of which and adjoining Mrs. Fox's house at Marybank the road to Montacute lies. On the way up was noticed a hill, on which was a luxurious growth of the large shivering-grass (*Briza maxima*), interspersed with a profusion of blue-bells (*Wahlenbergia gracilis*), and a few flowers of *Scævola microcarpa*. Further along the road were noticed *Brunonia australis*, the pretty pink native convolvulus (*Convolvulus erubescens*), that troublesome weed the wood-sorrel (*Rumex acetosella*), the small green orchid *Microtis porrifolia*, and the golden-flowered clover (*Trifolium agrarium*), an introduced plant. The coach stopped just by the church, this being as far as it was advisable to take a five-horse team, the road thenceforward being very steep, narrow, and winding, and from its appearance is commonly known as "The Corkscrew." When those who had walked up the hill had all arrived, a business meeting was held, at which Dr. Magarey (one of the Vice-Chairmen of the Section) presided. Five new members, including one lady, were elected, after which the Hon. Secretary (Mr. W. H. Selway, jun.) announced that they were on that occasion without a scientific leader, both Prof. Tate and Mr. J. G. O. Tepper being unavoidably absent. Members, however, could make their collections as usual, and would have an opportunity of obtaining any desired information concerning them at the evening gossip-meeting, which would be held in two or three weeks' time. The programme of the afternoon's proceedings having been announced, the party started to walk down the "Corkscrew." A short way down on the left-hand side is a large mass of rock, some of which has been detached, apparently the result of a landslip. Leaving the road on the right, and walking in a northerly direction, the top of a hill was soon reached, from which a magnificent panoramic view of the surrounding country was obtained. Near the top of the hill a few honeysuckle trees (*Banksia marginata*) were observed. A turn to the right was now taken, and the descent to the road commenced. The seeds of the *Acæna ovina* and the spiky balls of *A. sanguisorbæ* were exceedingly plentiful on the hillside. On getting near the foot of the hill, *Tricoryne elatior* (yellow), *Hypericum japonicum* (St. John's wort), and *Burchardia umbellata* (the last two in both fruit and flower) were collected. Other plants met with were the Forget-me-not (*Cynoglossum australis*), *Haloragis teucrioides* (a small red

Digitized by Google

flower), two everlastings, viz., *Helichrysum apiculatum* and *H. lucidum* (a much larger and handsomer flower), *Goodenia geniculata*, *Senecio lautus*, *S. hypoleucus*, and the small pink gentian (*Erythræa australis*). The road having been reached, the party visited the garden belonging to Mr. Curnow. Shortly after 6 o'clock the coach started for town, which was reached at half-past 7.

Third Excursion—Saturday, December 12, 1885.—Waterfall Gully.

On Saturday, December 12, twenty members and friends made an excursion to Waterfall Gully, leaving the Old Exchange at 2 o'clock in one of Hill & Co.'s coaches, and proceeding via the Greenhill-road. The coach stopped at Mügge's hotel, whence the party started in the direction of the Waterfall, under the leadership of Mr. J. G. O. Tepper, F.L.S., who, as they proceeded, called attention to the geological features of the side of the hill, which had recently been cut away in order to widen the road. In a short time the first fall was reached, the appearance of which has been considerably altered since the dam was erected to form a reservoir at the foot of it. A fine sheet of water now takes the place of what was formerly a stream of very small dimensions; but the general opinion seems to be that the natural beauty of the spot has been destroyed by the rude hand of man in carrying out this work. The steep climb to the top of the fall was the first hard work in the day's proceedings. On the way up *Ptilotus spathulatus* was found. Arrived at the summit the rocks were noticed to consist of clayey slate inclined at very high angles, and much harder than the rocks below. The polished surface of some of the slates now standing some distance out of the water was stated to have been caused by the action of the stream when running with greater force, and sufficiently high to submerge the slates. On the way up a wingless carnivorous locust was found, and capable, it was said, of inflicting an unpleasant bite. The formation of the waterfall having been discussed, and the view from its summit admired, a move onwards was made. The locality now became interesting to botanists, this part of the gully, fortunately for the Field Naturalists, having been left in its natural state. It was pleasing to see a notice-board cautioning people against taking away ferns and other plants, and it is only to be regretted that this step was not taken long ago. The first plant to attract attention was the shrub *Leptospermum lanigerum* in flower, and which always grows near water. *Lobelia anceps* (blue), *Polygonum minus* (red), and *Gratiola peruviana* (pale

Digitized by Google

pink) were next met with, and the sedge *Cladium psittacorum* were also noticeable, the spikes of which in parts were six to eight feet high, this being our tallest sedge. Of course many kinds of ferns were seen, the principal being *Todea barbara* (the nearest approach to a tree-fern in this colony), the broad-leaved *Lomaria capensis*, *Adiantum æthiopicum* (maiden-hair), and *Gleichenia circinata*, the elegant foliage of which is so suitable for decorative purposes.

The second waterfall was now reached, and it was on the face of this that the tree-ferns just mentioned were first noticed. A little way beyond the fall *Cladium tetraquetrum*, with its sharp-edged leaves, and *Carex pseudocyperus* were gathered, the latter being attacked by a uredo or smut. Another stiff climb had now to be attempted, and after going some distance up the hill a rest was indulged in. Near the track which leads to the Eagle-on-the-Hill, and on the side of the hill overlooking the third waterfall, were *Siegesbeckia orientalis* (in fruit), *Spyridium spathulatum* and *vexilliferum*, *Aster Huegeli*, *Persoonia juniperina*, *Comesperma calymega*, the parasitic plant, *Cassytha glabella*, and that pretty grass, *Poa nodosa*. The hillsides were thickly covered with *Eucalyptus cosmophylla* (hill mallee), the tallest of which were not more than twelve feet high, while at Kangaroo Island it reaches a height of twenty and thirty feet. Amongst these mallees, the pretty white immortelle, *Ixodia achilleoides*, was very plentiful, and contrasted well with the green colour of the eucalypts. In this locality, too, were seen *Acacia vomeriformis*, which is peculiar to this neighbourhood, *Hakea rostrata*, *Pimelea glauca*, *Grevillea lavandulacea*, and the graceful climber, *Marianthus bignoniaceus*. Descending towards the creek a very handsome orchid was collected, viz., *Dipodium punctatum* (the only orchid seen during the day). The peculiar *Candollea* (*Stylidium*) *graminifolia*, with sensitive style, attracted a good deal of notice. The party had now arrived near the chief sources of the Waterfall Creek, and progress was rendered very difficult owing to the thick growth of *Cladium tetraquetrum*, *Xanthorrhœa semiplana*, and other plants. It was about here that the fern *Gleichenia circinata* was principally found. Here, too, was seen that most interesting carnivorous plant, *Drosera binata*, this particular species being the most destructive of the Droseras to insect life, and is only found in few localities near the city. Various insects were found imprisoned on it, and some already dead, amongst them being a large tipula. Even an ant of considerable size had a difficult matter to free itself from the sticky secretion. It bears a white flower of a rather large size in comparison with the plant itself. It was now thought to be time to turn back, and on the way *Styphelia fas-*

Digitized by Google

ciculiflora was pointed out, the fruit and flowers growing at the foot of the stem, and quite close to the ground. Another plant of some interest was *Acacia verticillata*, the spiny phyllodia of which are grouped in whorls. On returning to the second waterfall a short rest in its picturesque vicinity was indulged in, after which the party retraced their steps to the Gully Hotel, where tea had been prepared for them, after partaking of which they started for the city, which was reached at 8.30 p.m.

FOURTH EXCURSION—FRIDAY, JANUARY 1, 1886.—RIVER ONKAPARINGA (NEAR HACK'S BRIDGE).

About 30 ladies and gentlemen started by coach about 9 a.m. and proceeded to the Hon. D. Murray's residence, on the Echunga-road. In the stringybark region, near the Eagle-on-the-Hill, a few of the stringybark gums (*Eucalyptus obliqua*) were bursting into flower, as well as a species of acacia (*A. retinodes*) growing along the rivulets on the eastern declivities, and looking very like the willow at a distance. Luncheon was partaken of under Hack's Bridge, during which it was noticed that the bed of the Onkaparinga is here impeded by protruding bosses of coarse Palæozoic schists, between which large and deep pools are formed, wherein the large *Triglochin procera* abounds, this plant being remarkable for its spikes of spirally-twisted fruits, seated so loosely upon their stalks that the slightest touch disconnects them. After luncheon the party proceeded up the river a little way, and then divided into two groups—one under the guidance of Mr. Murray following the northern, and the other, with Mr. J. G. O. Tepper as leader, taking the southern bank of the river. A water plant (*Myriophyllum variæfolium*) attracted attention owing to the great diversity between the leaves above and those below the water. Its humble congener (*M. elatinoides*) was also seen on the moist margins of the river. Other noticeable plants were *Polygonum minus* (with pink flowers), *Lythrum thymifolia* (purple), and *Prunella vulgaris*, which has a dense head of blue flowers. The tall rushlike *Cladium articulatum*, with its dark-brown fruiting cymes and smooth cylindrical leaves with spurious joints, was conspicuous, as were several species of *Carex*, *Scirpus*, and other sedges, all of them affecting the proximity of water. The shrubs *Callistemon salignus*, *Bursaria spinosa*, and *Leptospermum lanigerum* were seen in bloom. Several fine specimens of insects were discovered on the shrubs, including a large black and green weevil (*Chrysolophus spectabilis*) and a rare longicorn (a species of *Rhytiphora*), besides a number of other interesting beetles, hymenopters, and flies. Of plants, the rare and local *Correa decumbens* (native fuchsia)

Digitized by Google

and the poisonous *Sium latifolium* were observed in unusual luxuriance of growth and flower. *Gompholobium minus* was seen in flower and fruit, and the fruits of *Grevillea lavandulacea* were gathered abundantly in the adjoining scrub. The pretty Australian Indigo *(Indigofera australis)* was plentiful, but not in flower or fruit, as it blooms in October. Other examples of the rarer plants collected were *Helichrysum rutidolepis* (a yellow everlasting) and *Calocephalus lacteus* (white), both in flower. The seeds of that beautifully-flowered iridiaceous plant *Patersonia longiscapa* were also gathered. A large scorpion was secured by one of the party. After a long walk the two parties returned, and at half-past four were entertained at tea by Mr. and Mrs. Murray, who, on the motion of the Chairman of the Section (Dr. Cleland), seconded by Mr. Tepper, were accorded a hearty vote of thanks. At half-past five the return journey was commenced, and the city reached at 8.30 p.m.

FIFTH EXCURSION—SATURDAY, FEBRUARY 6, 1886.—MOUNT LOFTY (EASTERN SLOPE).

About thirty members and friends proceeded by the 1.15 p.m. train to Mount Lofty Station. Passing through Stirling West, a north-westerly direction was taken, with a view of striking the gullies at the foot of the Mount, this being the habitat of the Lycopods, the search for which was the principal object of the excursion. Owing, however, to none of those present knowing the exact locality, and there being insufficient time for lengthened observations, the Lycopods were not found. On the way a few interesting plants were observed, either in flower or fruit, the most conspicuous being *Ixodia achillioides*. On the side of a rivulet the musk plant *Mimulus moschatus* was growing luxuriantly. At the same place, in thickets, the local restiaceous plant *Calastrophus lateriflorus* was seen; also *Patersonia longiscapa* and *Polygonum minus*. The leafless *Viminaria denudata* was noticed to be affected with a peculiar gall. A single specimen of the orchid *Dipodium punctatum* was collected. Other plants met with were *Lobelia microsperma* and *Epacris impressa* (the latter exhibiting its summer flowers), and a tall sword rush (*Lepidosperma concavum*), also in bloom. After a long walk the party returned to the city shortly after 6 o'clock.

SIXTH EXCURSION—SATURDAY, MARCH 6, 1886.—ALDGATE.

A few members left the city by the 1.15 p.m. train. Passing Government Farm, it was noticed that the peppermint gums

Digitized by Google

(*Eucalyptus odorata*) were in full flower. On arriving at Aldgate Station the party were met by Mr. J. W. Bussell. It was intended to have ascended the creek at Aldgate, but, acting on the advice of Mr. Bussell, a course was struck for Cox's Creek, the route lying through Aldgate North. The walk in this direction is a very pretty one, and discloses some very fine views of the eastern slope of Mount Lofty and the adjacent country. At this time of the year flowers were, of course, exceedingly scarce, and consequently very few were obtained. One of the first to be noticed was the hardy introduced *Hypochæris radicata*. In the scrub land in the vicinity of Aldgate North *Epacris impressa* was already in flower. A few specimens of *Lobelia microsperma* were obtained, and the white everlasting (*Ixodia achilleoides*) was fairly plentiful. After walking about a mile and a half the party struck Cox's Creek at a spot from which a charming view was obtained. On the side of the hill were huge masses of rock covered with moss, while in the creek below were ferns of various kinds, the most noticeable of which were *Todea barbara* and *Lomaria discolor*. The rich green foliage of a handsome blackwood tree (*Acacia melanoxylon*) formed a pleasing background to the picture. On the banks of the creek were the silver wattle (*Acacia retinodes*) and *Bursaria spinosa*, the latter being still in flower. On the way some microscopical specimens were collected in Dunn's Dam. On arriving at Bridgewater the main road back to Aldgate was taken, where tea was obtained. The party left by the 7.30 train, reaching the city at 8.45.

Seventh Excursion—Saturday, April 3, 1886.—Glen Stuart.

Between thirty and forty members and friends proceeded to Glen Stuart—the gorge in the hills east of Adelaide from which the Fourth Creek emerges, and in which are situated the Morialta Waterfalls. It is by this latter designation the place is more generally known. Unlike Waterfall Gully at Burnside, Glen Stuart has fortunately suffered little from man's interference. On arrival at the entrance of the glen, and before commencing the walk, a short business meeting was held, Mr. J. G. O. Tepper, F.L.S., presiding. A vote of thanks was passed to Mr. Clement Sabine (agent for Mr. Price Maurice, to whom the property belongs), for kindly granting permission to the Section to go over the estate and take any specimens. The meeting over, the party started to walk up the glen, the Hon. Secretary (Mr. W. H. Selway, jun.) leading the way. After proceeding a short distance attention was called to patches of soft white rock on the bare hills, clinging to the surface or

Digitized by Google

occupying shallow depressions. Professor Tate, F.G.S., F.L.S., explained that the rock was a magnesian travertine, and was formed by the decomposition of the talcose and chloritic slates supplying the calcareous matter, which was redeposited by the water on its way from the higher to the lower levels. It was a truly chemical deposition, and was at the present time in process of formation. These observations also apply to the North Adelaide limestone, which is of the same chemical nature. Amongst the débris at the foot of the slopes fragments of quartz rock simulating coral structure were conspicuous. This was explained to be consequent on the laminated or pseudo-prismatic structure of the quartz rock being brought into relief by weathering. The first plant to attract attention was *Logania longifolia*, growing on the banks of the creek, while in the water itself was noticed *Triglochin procera*. The shrub *Aster axillaris* (which is usually seen on the sea coast, but with larger leaves) was still in flower. The teatree, *Leptospermum lævigatum*, was exceedingly abundant in the bed of the creek, and at times its overarching branches rendered progress rather difficult. Two acacias were seen, viz., *A. retinodes* (in flower), and *A. rupicola*, the latter being much less common than the former. Plants that attracted considerable attention were *Correa speciosa*, remarkable for its green flowers, *Spyridium spathulatum*, the green leaves, white bracts, and brown flowers of which formed a pretty contrast, and *Styphelia australis*. Several honeysuckle trees (*Banksia marginata*) were noticed. The party had now arrived at a point were some exceedingly bold and lofty fronts of rocks were conspicuous. Professor Tate pointed out that the higher part of the gorge was formed of quartzites or grits, the jointed structure and somewhat thickly bedded nature of which gave to some of the jutting points a castellated appearance, and to others a mural aspect. These bands, which trend north and south, are probably the same as those which form the waterfalls in the hills near Adelaide, from Belair northwards, and were not to be confused with the soft, gritty sandstones that form the summit of Mount Lofty. The thickness of the bed of quartzite was probably 300 feet or more. Rain now began to descend, and detained the party some time, but as soon as it had ceased they were not long in reaching the first waterfall. Notwithstanding the dryness of the season a moderate stream of water was falling over, and formed a nice pool beneath. The height of the actual fall of water is about 70 feet, the character of the rock causing it to maintain a perpendicular front and prevents its being rapidly worn away. The waterfall is shut in on either side by very high walls, from the sides of which the hairy-looking leaves of *Cladium filum* hang down, while near the summit the curious

Digitized by Google

grasstrees (*Xanthorrhœa quadrangulata*) are conspicuous. The pool at the foot of the fall is prettily lined with plants of various kinds, amongst which are *Arundo phragmites*, the sedge *Cladium mariscus*, and several species of juncus. A rare marsh plant, *Meionectes Brownii*, was also seen in the vicinity. The face of the rock near the waterfall, as well as elsewhere, was in parts disfigured by large black patches, caused by a species of lichen which grew where the water was accustomed to trickle down in winter. There was not sufficient time to proceed beyond the first waterfall, so after a careful inspection of the place, and in view of the probability of heavy rain, the party returned to the coach, which left the glen in time to reach the city at about half-past six.

EIGHTH EXCURSION—SATURDAY, APRIL 10, 1886.—FLETCHER'S DOCK, PORT ADELAIDE.

A special excursion was made on this date, when a visit was paid to Fletcher's new graving dock at Port Adelaide. The party, to the number of about twenty, left by the 1.50 p.m. train, and on arrival at the Glanville Station were met by Mr. H. C. Fletcher, who had anticipated the visit by having nearly all the water pumped out of the excavation, so that the members might descend to the bottom of it and make a thorough examination of the place. Under the guidance of Mr. Fletcher, who has been much interested in the geological features brought to light as the work progressed, the party were first taken to view it from the top of the banks, and then descended to the bottom. Having surveyed the interior of the excavation, and noticed its many interesting features, the party ascended to the surface level, and on arrival at a spot on the bank whence a good view of the exposed section was obtainable, Mr. W. Howchin, F.G.S., addressed the members. After apologising for the absence of Professor Tate, he proceeded to draw attention to the chief points of interest in the geological section before them. It was rarely, he observed, that so extensive a section of the recent marine beds of the locality was open to observation as was now afforded by the excavation before them. The section was a particularly interesting one, affording, as he believed, some evidence that these recent marine beds were not one uninterrupted succession of marine deposits, but that they in reality were made up of two marine fossiliferous formations, with an old land surface intermediate and separating them. If they looked carefully at the section before them, they would be able to trace certain lines of stratification. The first six feet at the top was simply "made ground." Then followed one foot of

Digitized by Google

clay, which was at or about high-water mark; sixteen feet of bluish-white sand, very fossiliferous—oysters, pectens, venus, pholas, and small gasteropods occurring in immense numbers. Below this was a bed about six feet thick of sandy blue clay, with fewer fossils, whilst below this again was a bed of sandy brown clay from four to six feet, which to all appearance was perfectly devoid of fossils. Underlying this brown clay a bed of limestone occurred about four feet thick, generally soft and friable, but covered on its upper surface by a crust of hard travertine. This limestone, except in the portion forming the crust, was extremely rich in organic remains. There were, therefore, two sets of beds rich in fossils, with an intercalated clay-bed quite destitute of organic remains. This clay-bed, Mr. Howchin proceeded to say, had every appearance of being terrestrial in its origin, and he gave at some length the evidence which had led him to this supposition. There was also a certain difference in the fauna of the upper and lower marine beds of the section which ought not to be overlooked in its bearing upon this question. Habitat might account for some of these differences, but scarcely explained the whole of the phenomena. In the upper sand-bed all the forms were both recent and still common on our coast and in the Gulf. In the lower marine bed, represented by the limestone, all the forms specifically agreed with living Australian shells; but some of these, such as *Arca trapezia* and the large foraminifer, *Orbitolites complanata*, whilst still existing in the eastern and warmer waters of Australia, were locally extinct with us. He (Mr. Howchin) would not as yet speak dogmatically on the matter, but he considered there was strong presumptive evidence, borne out by many collateral lines of proof, that there was shown in this section a break in the continuity of deposition, and consequently an older and newer series of recent marine formations on our seaboard.

A hearty vote of thanks having been passed to Mr. Fletcher for the trouble and interest he had taken on behalf of the visitors, that gentleman suitably responded, and then took the party to the office, where several fossiliferous and other specimens were on view, some of which gave rise to an interesting discussion. The members then took leave of Mr. Fletcher, and most of them proceeded for some distance in the vicinity of the river's bank, noticing *en route* a number of rounded flints scattered over the flats. Not far from the water's edge two varieties of the salsolaceous plant *Salicornia*, viz., *S. arbuscula* and *S. australis*, were plentiful, and their peculiar flowers attracted considerable attention. The fruit of *Scirpus nodosus*, that useful plant for preventing the drifting of sand, was also gathered. Some material for future microscopic study having been

Digitized by Google

gathered from a likely looking pool of water, the party deemed it time to turn back, and took the ferryboat for the opposite shore. Having still a little time at their disposal, they paid a short visit to the Museum, and then returned to the city, arriving there shortly before 6 o'clock.

An excursion to Kangarilla was fixed for Easter Monday, April 26, but owing to an insufficient number of applications, it was not carried out.

NINTH EXCURSION—SATURDAY, APRIL 24, 1886.—TRAWLING IN ST. VINCENT GULF.

As a change from their usual country excursions, it was determined to spend a day or two on the briny. All arrangements had been made to start on Thursday evening, April 22, the intention being to proceed to Port Vincent and spend the two following days in dredging, trawling, fishing, and collecting on shore. Owing, however, to the extremely boisterous state of the weather on Thursday, and to the prospect of its continuance, it was decided on the afternoon of that day not to start under such unfavourable conditions. Most of those who had intended to join the party met at the North-terrace Railway Station on Thursday evening, Captain Weir, of the Ariel (the steamer engaged for the occasion), being also present. After a good deal of discussion it was decided to wait until Saturday morning before venturing on the deep, it being thought that by that time the force of the storm would have abated. Accordingly the party assembled shortly before 8 o'clock on Saturday, and left by the 8.5 a.m. train. On reaching the Semaphore the Ariel was ready to start, but it was found that the trawling apparatus was not on board. After waiting for some considerable time it was suggested that, pending its arrival, a preliminary trip of an hour or so should be made with an oyster dredge belonging to the steamer. This idea met with approval, and a start was at once made. As the sea was pleasantly smooth and a gentle breeze blowing, the outlook for an enjoyable trip was very favourable. After steaming for a mile or two the dredge was thrown overboard. On being hauled up the contents were found to be mostly weed, but there was also a catfish and other forms of animal life. There was not a great deal taken in successive hauls, and the time having expired the steamer returned to the jetty. On reaching the latter it was found that the trawl, with other apparatus from the Museum, had arrived at the jetty a few minutes after the steamer had left. It was now too late to go to Port Vincent, so it was de-

Digitized by Google

cided to steam ten or twelve miles out into the deepest part of the Gulf. The trawl safely aboard and luncheon over, another start was made. After steaming for about an hour and a half, the trawling was commenced, and continued during the afternoon under very favourable conditions, the light wind of the morning having died away, and the sea became almost as smooth as a millpond. The first two hauls consisted chiefly of scollops (*pectens*), and several members of the party testified to the superiority of these to oysters for edible purposes. Amongst the spoil were fish with poisonous barbs (*Apistes marmoratus*) and a species of gurnet. There were sea-worms, sea-urchins (*Echinus*), and sea-dragons (*Phyllopteryx foliatus*). A tiger shark of a rather rare species was also captured. There were also the brilliantly-marked ostracions, and some species of *Cephalopoda*, including *Sepia brevimana*. Crabs, with their bodies covered with seaweed, attracted much attention. Two or three large and prettily-marked starfish also came up in the trawl. There were plenty of sponges, the tunnels of which were occupied by worms that were summarily ejected from their homes. Several leather-jackets (*Monocanthus*) were brought up, as also were some *Holothuriæ*. Not the least interesting were some beautiful polyzoa. The results of this trawling trip brought some new specimens to light. Just as it was getting dark a short time was spent on the schnapper ground, but without success, so lines were taken in, and the steamer returned to the jetty, the party returning to town by the 7.10 train.

Tenth Excursion—Monday, May 24.—Marino to Hallett's Cove.

Between twenty and thirty ladies and gentlemen left the city by the 9 a.m. train for Glenelg, and alighting at Miller's Corner, proceeded by tram to Brighton. Under the leadership of Professor Tate, a direct course was struck for the rocks. The tide being low and the sea quiet, advantage was taken of these conditions to observe molluscan and other marine animals in their native haunts. *Patella limbata*, *P. gealei*; the first conspicuous from its large size, the second from its gorgeously-painted interior were taken; also *Acmæas*, of which genus *A. conidea* was common. There was also *Siphonaria diemenensis*, which, though like the limpet externally, differs from the latter in that it breathes air, and its activity while the water is receding is in strong contrast to the sedentary habit of the other Patella-like shells under the same circumstances. Conversely, as the animals become immersed by the rising tide, the Patellas are out feeding while the Siphonarias are inactive. In a few marked instances it was satisfactorily

Digitized by Google

concluded that the limpet came back to the same resting-place that it had previously occupied. Then of the Periwinkles may be mentioned the small bluish-white *Littorina Mauritiana*, which from its abundance appeared in marked relief to the sombre-hued rocks to which it was attached. Of allied forms were *Risella plana*, the black hemispherical *Nerita punctata*, the roundly-conic and greenish *Trochocochlea striolata*, *Turbo undulatus*, and, lastly, the large *Chiton petholatus*. Here and there were clusters of the small black mussel, *Mytilus ater*. This is the first recorded notice of the occurrence of this shell, although it has been known for some years past to Professor Tate as a denizen of St. Vincent Gulf. Nestling amongst the colonies of mussels was the somewhat delicate *Lasæa rubra*, so called from the red colour of its apex. Mr. Zietz, of the Museum, obtained from the rock-pools an interesting collection of small fish and crustaceans, some of which he supposes to be additions to our fauna.

Some little attention was given to the formation of the shingle and conglomerate met with on the coast, and explanation was offered respecting the rugged character of the rocks exposed to the surf. This was stated to be due to the close reticulation of veins of a harder material than the matrix, the former being better able to resist the denuding action, and consequently standing out in bold relief.

Having walked about a couple of miles over the uncertain footing of the rocks, and made the collections just recorded, it was decided to rest awhile, during which luncheon was partaken of. Some of the members then ascended the cliffs, and continued the walk a short distance inland, when the following live land-snails were found under stones, viz.:—*Stenopus rusticus*, *Helix Bednalli*, *H. arenicola*, *Bulimus Adelaidensis*, and *Succinea australis*. At one of the stream-courses a fresh-water shell—*Bulinus tenuistriatus*—was met with.

On the way to the Cove a fair number of plants proved interesting, but it was much too early in the season to see the flora of this locality to advantage. Amongst the first to be noticed was the small yellow star-like *Hypoxis pusilla*, which on account of its invariably early appearance may be regarded as the harbinger of the floral season. The most profusely-flowering plant was probably *Aster axillaris*, the presence of which enabled members to note the difference this shrub presents with regard to habitat, whether on the coast or in the hills, such as at Glen Stuart, where it was recently gathered. Two species of *Xerotes* were met with, viz., *X. effusa* (remarkable for its sweet scent) and *X. dura* (the latter in fruit only). Then there were *Salsola kali* (potash plant), the pretty yellow *Oxalis corniculata* (commonly known as the native Wood

Digitized by Google

Sorrel), *Atriplex semibaccata* (the specific name of which implies "half-berried"), and *Zygophyllum fruticulosum* (the leaves of which, as its name indicates, are each composed of two —and only two—leaflets). On the banks of a creek *Tetragonia implexicoma* was very abundant, differing in this respect from *Lycium Australe*, one colony only of this local plant being noticed. Of other flowering plants may be cited *Styphelia humifusa*, *Spergularia rubra* (a small red flower), and *Myoporum humile*, the rich green foliage and delicate flowers of which covered a mass of rock, and presented a very attractive appearance. Although not in flower, *Scleranthus pungens* deserves mention on account of its comparative rarity.

Approaching still nearer to Hallett's Cove, the most interesting discoveries of the day were made in the shape of some fine specimens of glaciated rock-surfaces. These are perceptible quite a mile from the site where first discovered nine years ago by Professor Tate, and are more or less continuous. At the original site, which is about a quarter of a mile from Black Point (the northern headland of Hallett's Cove), the rock, although smooth, does not show polishing, being a rather soft shale. On account of its softness, however, the grooves are particularly well defined; but further north the ice has moved over quartzite rock, which is highly polished, though from its greater hardness, striations are but faintly perceptible. Australian geologists have been slow to admit the interpretation Professor Tate has put on these polished and striated surfaces, chiefly because the facts were not consonant with preconceived theories touching such climatic changes in these low southern latitudes as are indicated by the glacial origin of these smooth pavements. It need hardly be added that this example of glaciation is quite unique for Australia. It has been examined by several geologists from Canada, Europe, and India, who have unanimously corroborated Professor Tate's interpretation.

Some time was occupied in extracting fossils of the Older Tertiary age from the coarse silicious sandstone forming an interior cliff near Black Point. A geological feature not observed when on a prievous visit to the same locality was a dislocation in the strata, quartzite bands being noticed in juxtaposition with purple slaty shales, which were several feet above them in the vertical series.

After a short rest the party returned to Brighton, and reached the city at about 6.45 p.m.

Eleventh Excursion — Monday, June 21, 1886. — Patawalonga Creek.

About a dozen members and friends left town by the 10

Digitized by Google

o'clock train for Glenelg. Guided by Mr. J. G. O. Tepper, F.L.S., a course was struck for the banks of the Patawalonga River. The attention of the party was soon directed to the salsolaceous plants found near the river. Of these may be mentioned *Sueda maritima* (in flower), with its long succulent leaves and straight stems; *Salsola kali* (in flower and fruit), the pointed scale-like leaves of which require careful handling; *Nitraria Schoberi*, a shrub with grey thick leaves about an inch long, and having an oblong and curiously pitted seed; and *Salicornia australis*, which, having no leaves, is formed of short cylindrical fleshy joints, first green, then red, and finally woody; its fruit was pointed out at the end of the joints. The bank of the river is lined more or less continuously with *Melaleuca pustulata* (frequently called "tea-tree"), the bark of which grows in thin paper-like layers somewhat resembling cork, and besides being supposed to make good paper, may be twisted and used as cord. The shrub *Aster axillaris*, which a month ago was covered with flowers, was now showing its young large leaves, which mostly fall off when flowering, and give place to much smaller ones. The native sarsaparilla (*Muehlenbeckia adpressa*) was conspicuous on account of its pleasing foliage. Buds, flowers, as well as the ripe fruits and seeds, were noticed on this elegant plant. The large sword-leafed sedge *Lepidosperma gladiatum* was pointed out as being recommended by Mr. A. Tolmer as an excellent material for making paper, &c.

After walking for about three miles along the river, attention was directed to the fossil-beds several feet below the surface of the bank. These contained shells similar to those now living on the coast. A great many specimens were gathered, of which may be mentioned *Pecten*, *Mactra*, *Modiola*, *Bulla*, *Conus*, *Ostrea*, *Pinna*, *Tellina*, *Cerithium*, *Cypræa*, *Columbella*, and three or four species of *Nassa*. On reaching a convenient spot a little further north, a halt was made for luncheon, during which Mr. A. Zietz obtained some small fishes from the creek, including species of *Gobius* and *Galaxias* (native trout). After luncheon the walk in the same direction was continued for a short distance, when a cutting exposed some rich beds of fossil-shells. Having made a collection of these, a course was struck for the military-road. On the road to Henley Beach, *Hydrocotyle asiatica* was met with, the leaves of which are smooth, dark-green, and heart-shaped, and the stalks very long. That narcotic plant *Datura stramonium* (thorn-apple) was observed to be growing on the roadside, its numerous seedpods ready to be distributed by cattle or other agency. An immense number of native melons (*Cucumis microcarpum*) were seen. These are often erroneously regarded as poisonous, but

Digitized by Google

have been the means of preventing cattle and sheep from starving. On the military-road some friable rock fragments were also observed to contain shells similar to those previously referred to. On arriving at Henley Beach township a short rest was made, and then the party walked towards Glenelg along the sea-shore. Owing to the absence of rough weather recently there was not a great deal to be obtained there. A large *Medusa* (jelly-fish), measuring a foot in diameter, was picked up, and proved to be a new species. On the sandhills were *Spinifex hirsutus*, so useful for binding drift-sand, and the globular female spikes of which are so plentiful on the beach; also *Mesembrianthemum æquilaterale*. A smaller species (*M. australe*) was growing nearer the river. The party arrived at Glenelg in time for the 6.15 train, and reached the city about half an hour later.

TWELFTH EXCURSION—WEDNESDAY, SEPTEMBER 1, 1886.—GLEN STUART.

Between thirty and forty members and friends proceeded to Glen Stuart on September 1st. The recent wintry weather had not favoured the early appearance of flowers, but there were a good many gathered during the day. Leaving the Town Hall in one of Hill & Co.'s coaches shortly before 10 a.m., the party arrived at their destination about an hour later, and at once started up the gully, Mr. J. G. O. Tepper, F.L.S., being the leader. They halted for luncheon at the foot of the First Fall, over which a fine body of water was flowing, the rains of the previous day or two having swollen the stream considerably. Subsequently some of the party pushed on to the Second Fall, a little beyond, this part of the journey involving some very stiff climbing. The most interesting flowers gathered were orchids, of which the following varieties were found:—*Pterostylis reflexa*, *P. curta*, and *P. nana* (all hooded), *Caladenia deformis* (blue) and *Corysanthes pruinosa*, a peculiar semi-hooded brown flower. An interesting discovery was the finding of *Anthocercis angustifolia*, this being a new locality for it, Stonyfell, near Burnside, being the only locality near Adelaide where it had previously been gathered. Other plants in flower were *Hakea rostrata*, the scarlet *Styphelia Sonderi*, its less conspicuous but more elegant congener *S. australis*, *Daviesia ulicina* (brick-red flowers and sharply-pointed leaves), *Pimelea ligustrina* (white) and *Goodia medicaginea* (yellow). Several species of *Drosera* were also collected. The geological and other features of this interesting locality have been previously described, this being the second visit to this place. The party returned to the city shortly before 6 p.m.

Digitized by Google

THIRTEENTH EXCURSION—SATURDAY, SEPTEMBER 18, 1886.—GOVERNMENT FARM.

Hitherto the earliest month Government Farm had been visited by the Section was October, but the Committee decided to try an earlier date this season, and fixed an excursion for Saturday, September 18. The wisdom of this decision was shown in the success that attended this visit, and which was largely due to the favourable weather of the previous few days. Over thirty members and friends of the Section started by the 1.15 p.m. train for Belair. On reaching the station a short consultation as to the route to be taken was held, and then the party proceeded along the railway line as far as the entrance gate. Arrived within the enclosure, a short business meeting was held, after which the party moved off in two divisions, one under the guidance of Mr. Tepper, F.L.S., the other having Professor Tate for leader. A somewhat more westerly direction than followed on previous occasions was first taken, so as to cover new ground, this route leading into the heart of Government Farm. Flowers being very numerous, no time was lost in starting operations. One of the first to be gathered was *Hibbertia stricta* (yellow), closely followed by *Styphelia strigosa*, whose delicate wax-like flowers of tubular shape are well protected by sharply-pointed leaves. A rather conspicuous plant was *Pultenæa largiflorens*, whose yellow flowers cluster thickly round its stem. A very similar flower was *Bossiæa repens*, the difference apparently consisting in its larger leaves and filiform stem. Ere long the orchids came in sight, of which the following were gathered during the afternoon. *Calochilus Robertsoni* should, on account of its rarity, perhaps be mentioned first, though only one specimen was found. Last October was the first time this orchid was gathered on Government Farm. Four species of Diuris were collected, viz., *D. palustris*, *D. maculata*, *D. pedunculata*, and *D. longifolia*. Of the Caladenias there were *C. Patersoni*, with three or four of its varieties, *C. carnea*, *C. Menziesi*, *and C. latifolia*. A pure white flower, very similar in form to the last named, was met with, and may either be an albino of that particular orchid, or else a new species. Then there was *Glossodia major*, purple and almost pure white specimens being found. Only one Thelymitra was met with, viz., *T. antennifera*. Lastly comes *Acianthus exsertus*, a local and early orchid, flowering from July to November, according to locality. It will thus be seen that no less than twelve species of orchids were collected in addition to several varieties. Other flowers worthy of note met with in that part of the Farm first explored were the yellow *Hypoxis glabella*, *Tetratheca ericifolia*, and *Chamæscilla corymbosa*. Both staminate and pistillate flowers of *Anguillaria dioica* were noticed; some-

Digitized by Google

times both are on the same plant. Growing alongside the watercourses were the shrubs *Myoporum viscosum* (with a pretty white flower) and *Dodonæa viscosa*, the leaves of these two being very similar. After walking for about a mile the two parties converged, and a short rest was made. As the party had to walk to Mitcham, it was not deemed advisable to proceed further into the Farm, and a course was therefore struck for the scrubland on the north-eastern part of the reserve adjacent to the railway line, where an altogether different kind of vegetation is met with. Here the thorny Hakeas reign supreme, and are associated with the Leptospermums and the Xanthorrhæas. Both *Hakea rugosa* and *H. rostrata* were in flower. The red pistillate flowers of the shrub *Casuarina distyla* attracted attention from their peculiar appearance. It was in this scrubby region that the rare orchid *Calochilus Robertsoni* was collected. Having again reached the southern boundary of the Farm some of the party crossed the railway line with the intention of making for Brownhill Creek. As, however, it was still early, and the sun's rays very warm, a portion of the party spent a longer time in its precincts, after which they proceeded towards the Brownhill Creek road. On the way attention was called to a cluster of the caterpillars of a species of Sawfly (*Perga polita*) on the stem of a eucalypt. It was explained that during the day these caterpillars huddle together as then seen, and in the night make for the leaves of the tree, marks of their depredations being plainly visible. In a rocky ravine a shrub of *Logania longifolia* was noticed in full flower. A native marshmallow (*Lavatera plebeia*), which bears a beautiful and large white flower, was also seen there. It is now getting somewhat rare, being generally found only in inaccessible places, such as in this gully. After a very rough walk the party arrived at Mitcham, and returned to the city by an early train.

Fourteenth Excursion—Saturday, October 2, 1886.—Golden Grove.

The first of the fortnightly excursions arranged for during October took place on this date, when about twenty ladies and gentlemen proceeded to Golden Grove, fourteen miles north-east of Adelaide. On account of the distance an early start was made, the party leaving town in one of Hill & Co.'s coaches about 1.30 p.m. A great quantity of the acacia known as the kangaroo hedge is passed on the roadside, and is now in full bloom. The coach pulled up near the Cemetery at Golden Grove, in order to explore the adjacent sandy scrub, which is noted for its floral wealth. Prior to entering this, however,

Digitized by Google

Professor Tate took the party along the road for a little way to search for a plant—*Quinetia D'Urvillii* by name—which was not known outside of Western Australia till a few years ago, when the Professor discovered it in this locality. Then it was rather plentiful about here, but now it seems to be scarce, as some little time was spent in finding it. It is a very small, light-yellow, composite flower, and requires the aid of a magnifying glass to properly distinguish its structure. As the flowers begin to fade they present very much the appearance of a small camel-hair paint-brush. The only other locality in this colony where it has been noticed is on the hills near Brighton. It flowers in September, and soon succumbs when the hot weather sets in. When looking for this plant a nest of remarkably large spiders of the genus *Isopeda* was discovered. On returning to the scrub-land no time was lost in getting to work, flowers being very numerous. Orchids of many kinds were gathered, including a new species of *Caladenia*. It resembled somewhat *Caladenia leptochila* in general form, being streaked with dark-brown lines, but it had a broad heart-shaped labellum. From this latter peculiarity it was decided to name it *C. cardiochila*. An orchid not previously met with in the excursions of the Field Naturalists, viz., *Lyperanthus nigricans*, was also gathered. It possessed the full number of flowers (five) which this species bears, and was a fine specimen of one of our handsomest orchids. Subsequently a good many others of the same kind were met with. All parts of this plant dry black, hence its name. Other orchids gathered during the afternoon were *Caladenia dilatata*, *C. Patersoni*, *C. carnea*, *C. latifolia*, *C. leptochila*, *Thelymitra aristata*, *T. McKibbinii*, *T. antennifera*, *T. nuda*, *Prasophyllum patens*, *P. fuscum*, *Microtis porrifolia*, *Pterostylis concinna*, *P. vittata*, and *Glossodia major*. Altogether about twenty different orchids may be gathered here. Of other plants the Fringe Lily (*Thysanotus Patersoni*), a flower of a pretty purple colour, came in for a good deal of attention. Of rare plants may be mentioned *Stackhousia monogyna* (light-yellow star-shaped flower) and *Stenopetalum sphærocarpum*. A white *Grevillea lavandulacea* was met with. Indeed, most of the flowers of this plant were of a lighter tint than generally seen in the hills nearer Adelaide. Two species of *Hibbertia* were collected, viz., *H. stricta* and *H. densiflora*. The handsome shrub *Calycothrix tetragona* was in full bloom. Both male and female flowers of *Opercularia scabrida* were noticed. Two flowers very much alike in colour and shape were *Dillwynia hispida* and *Pultenæa ruscifolia*. The flower of the latter is smaller than that of the former. Other plants more or less interesting that were gathered were *Pimelea humilis*, *P. octophylla*, *Brachyloma ericoides* (in flower and fruit),

Digitized by Google

Euphrasia Brownii, *Minuria leptophylla*, *Ptilotus erubescens* (in bud), *Styphelia cordifolia* (chiefly noticeable on account of its peculiar foliage), and the sedge *Lepidosperma filiforme*. A cluster of a species of Coccidæ (*Kermes Maskelli*—Crawford) was noticed on an acacia twig. A nocturnal lizard (*Phyllodactylus macrodactylus*) and a snail (*Helix Bednalli*) were collected. At half-past 5 the party reassembled at the coach, and the city was reached soon after 7 o'clock.

FIFTEENTH EXCURSION—SATURDAY, OCTOBER 16, 1886.—BLACKHILL.

Over thirty members and friends left town in one of Hill and Co's coaches shortly after 2 o'clock. The route taken was by the Payneham and Campbelltown roads as far as Mr. H. E. Downer's house, thence in a direct line past the Thorndon Park reservoir, and as near to the hills as the coach could conveniently get. After dismounting, a short business meeting was held, Mr. J. G. O. Tepper presiding. Two new members were elected, and those present were asked to collect flowers for the conversazione on the following Tuesday, the Chairman explaining the best means of keeping them fresh till that time. The party then moved off, the bulk making for the scrub at the foot of the hills, while some interested in the microscope preferred to explore a creek for specimens. In this stream were found the fresh-water shell *Limnea subaquatilis*. On reaching the scrubby country it was found that the Section had been well advised when they were urged to pay this locality a visit, as it is very rich in plant life. Its characteristics somewhat resemble a portion of Government Farm and the scrub near Lyndoch, although some species of plants found at the latter place are wanting here. Leptospermums, Hakeas, and Casuarinas are some of the most noticeable of the taller-growing shrubs; while *Calycothrix tetragona* is seen in the greatest profusion. One of our gums not often met with in these rambles was noticed, *Eucalyptus paniculata*, so named from its flower growing in panicles, which fact was practically demonstrable on account of the tree being in blossom. Several orchids were gathered during the afternoon, and included *Prasophyllum elatum*, a tall-growing variety, and a rare species, this being the first gathered by the Field Naturalists. Unfortunately, it had just done flowering. This specimen was about 2 ft. 6 in. high, and had a thick stem. On Kangaroo Island it attains a much greater height. Two other species of *Prasophyllum*, new to Professor Tate and Mr. Tepper, were collected. One was light-yellow and the other brown in colour, both resembling in structure *P. patens*, which was pretty common. *Pterostylis*

Digitized by Google

longifolia was seen for the first time this season, and was in fruit. Other orchids met with were *Glossodia major* (in flower and fruit), *Thelymitra nuda* (or *aristata*), *Caladenia leptochila*, *C. dilatata*, and the diminutive *Microtis porrifolia*. As might be expected at such a place in the month of October, flowers were very numerous, and only the more rare or interesting can be mentioned. Growing in almost tree-like form was *Hakea ulicina*, and, like its smaller congeners, was decidedly prickly. There were *Pultenæa brevifolia* and *P. acerosa*, the latter with handsome yellow flowers and sharp foliage. These belong to the order Leguminosæ, some of which, on account of the general similarity of structure, and sometimes also in colour, are difficult to distinguish. Others of the same order that were noticed are *Dilwynia hispida* and *Eutaxia empetrifolia*, the second of these being of an unusually slender form. *Viminaria denudata* is also a leguminous plant, and its pretty appearance in flower was a source of admiration. The white fluffy-looking heads of *Pimelea octophylla* attracted notice on account of their peculiarity. The white bracts of *Spyridium vexilliferum* make this shrub conspicuous for its foliage. A local plant—*Stackhousia monogyna*—gathered a fortnight ago at Golden Grove, was also seen on Saturday. *Isopogon ceratophyllus* was noticed in flower. It grows in thick prickly-looking clusters a few inches from the ground. The yellow *Velleya paradoxa*, the sedge *Lepidosperma concava*, *Cryptandra tomentosa* (in fruit), and *Didiscus pusillus* complete the list of the more noteworthy plants. Insects were rather numerous, some pretty moths, flies, and a black spider with red legs being amongst the "spoil." After walking some distance up the hill, from which elevation a splendid view of the surrounding country was obtainable, a course was struck for an adjacent gully. On reaching its entrance, however, one of the party who had just returned reported unfavourably of it, especially on account of its ruggedness, and as a lot of rough walking had already been done it was decided to abandon the gully and turn coachwards. At about 6 o'clock a start for home was made, the city being reached shortly before 7 o'clock.

Sixteenth Excursion—Saturday, October 30, 1886.—Highbury and the Gorge.

On this date an excursion was made to Highbury and the gorge. Considering that this was the third excursion in one month, there was a very fair attendance of members and friends, who left the city at 2 o'clock by one of Hill & Co.'s coaches. The coach pulled up about a couple of hundred yards past the Highbury Hotel, to enable the party to examine a piece of

Digitized by Google

scrub which the Secretary, in a preliminary tour of investigation the previous Saturday, had considered "likely" ground. The most noticeable floral feature at the time of this visit was *Burchardia umbellata*, the pretty white flowers of which were seen star-like all over the ground; while the pink and red *Grevillea lavandulacea* and the yellow *Hibbertia densiflora*, both of which were very numerous, formed a pleasing contrast of colour. A few orchids were found here, amongst them a very fine specimen of *Microtis porrifolia*, and several flowers of *Caladenia dilatata*. There were many other plants more or less common on scrub-lands, and though limited in extent, cultivation having spread close to it, the locality was well worth examining. From here, too, one of the most charming views in the colony is to be seen. After a short stay the party resumed their seats on the coach, and were conveyed about half a mile further, when they again left the conveyance at the junction of the road leading to the gorge. Adjacent to this track is another patch of scrub, which the party at once began to explore, the first botanical specimen to attract attention being *Stylidium calcaratum*, a tiny pink flower. A shrub whose pleasing foliage struck the eye was found to be *Prostanthera Behriana*, the bluish white flowers of which are also very attractive. Only one plant of this was seen here, but later in the day, along the foot of the hills on the southern side of the gorge, it was very plentiful. Soon the "everlastings" came under notice, no less than five species being gathered, viz., *Helichrysum apiculatum* (the most common one), *H. scorpioides*, *H. Baxteri*, *H. retusum*, (very small), and last, but very far from least, *H. lucidum*, our finest everlasting, and noted for its stiff, bright, golden-yellow flowers. It was this one that search was made for last year in an excursion to Highbury, but was not found, owing to the members not going far enough. It is mostly met with along the aqueduct, within a mile or less of the weir. Passing the brickworks, the road to the gorge was again reached, and with sundry deviations was followed till the aqueduct was arrived at. On the way clusters of *Aster axillaris* of luxurious growth, resembling somewhat the foliage of the rosemary, were passed. The angular prickly fruit of *Pultenæa brevifolia* and its generally peculiar appearance had many inquirers as to its identity. A rather rare plant near Adelaide that was collected was *Hibbertia fasciculata*, and the presence of the sedge *Lepidosperma concava* was explained to be always indicative of neighbouring water, probably not many feet below the surface of the ground. Conspicuous yellow flowers were *Podolepis rugata*, so called from the scaly appearance of its calyx, and *P. acuminata*, the latter being the largest of our compositæ. The grass *Hæmarthria compressa* (in flower), which

Digitized by Google

is generally met with alongside of rivers, was pointed out. Noticeable from its pretty red fruit was *Rhagodia nutans*, which was said to be good food for stock. On reaching the aqueduct its course was followed in the direction of the weir, and one of the party wishing to get a little out of the ordinary track, clambered up the hillside, and discovered *Anthocercis angustifolia*, this being a third locality for it. The only other places in which the Field Naturalists have previously come across it is at Stonyfell and Glen Stuart. It is a rare and local plant, with a white flower somewhat resembling a clematis. The white star-shaped *Stellaria glauca*, which favours moist hillsides, was also gathered. Not far from the weir the orchid *Pterostylis Mitchelli* was found. This is sometimes regarded as a variety of *P. rufa*, and sometimes as synonymous with that species. It is one of the hooded orchids, and has a greenish flower with brown ribs, its galea and lower lobes ending in long bristles, and its lips small but very sensitive. Another orchid (*Caladenia leptochila*) was seen during the afternoon. On the southern hillside Mr. Tepper discovered *Phyllanthus Gunnii*, a small shrub not previously known to occur so near Adelaide. Collections in other departments of natural history included specimens of lizards, moths, and fresh-water shells. The party proceeded as far as the weir, and after enjoying a rest in this picturesque spot, they returned to the coach, which left shortly before 6 o'clock, and arrived in town an hour later.

EVENING MEETINGS.

Summer Session.

December 15, 1885.

The first of a series of gossip meetings arranged for the summer months was held at the Royal Society's Room on Tuesday evening, December 15. There was a fair attendance. The meeting was of an informal character, and proved very interesting. Mr. J. G. O. Tepper, F.L.S., brought a large collection of the *Compositæ* of Ardrossan, and also some rare plants found in the neighbourhood of Adelaide. Other specimens in botany and geology were shown by various members, and some took the opportunity of getting their exhibits named. A well-executed painting by Miss R. C. Fiveash of the orchid *Dipodium punctatum*, found on the previous Saturday's excursion, was exhibited.

Digitized by Google

January 19, 1886.

A gossip meeting was held at the Public Library on this evening. There was a fair attendance of members. Dr. Cleland, who presided, exhibited and described some interesting geological specimens obtained from the neighbourhood of Lake Gilles, about fifty miles to the west of Port Augusta. The scenery of this district, according to the doctor, was very striking. A low range of table-lands contrasted strikingly with a chain of steep jagged hills. The former showed what appeared to be very clear traces of glacial action. A piece of conglomerate exhibited was cited as evidence of this, one side of the stone having just the appearance of rock when worn by ice, whilst the other was rough, and had evidently been subjected to no such action. Ironstone, almost wholly composed of iron, obtained from "Ironstone Knoll," and some splendid specimens of crystals of quartz, felspar, and sandstone got from near the same locality, were also shown by the same gentleman. Mr. R. H. Pulleine exhibited a case of beautiful butterflies, collected chiefly in Central and Southern America. Amongst others was a number of species characterised by transparent gauzy wings, appearing at first sight like large wasps. Unlike the latter, however, they are said to be very slow in their flight, and to spend a considerable portion of their time on the branches of trees. Several English butterflies, including the "peacock," "red admiral," "painted lady," and others, and a few of our scanty native Lepidoptera completed the collection. The same member also showed a beautiful little bird of a black colour, spotted with red patches, which together with its nest, formed of the white fluffy galls found on the Kangaroo acacia, was obtained in the vicinity of Cape York. After examining some further geological and other specimens the members dispersed.

February 16, 1886.

The monthly gossip meeting of the Section was held in the Public Library Buildings, Dr. Cleland presiding. Numerous specimens of minerals, plants, and other things were shown, and their scientific significance was explained by the President and Mr. Tepper, the latter of whom showed a particularly good and well-mounted botanical collection obtained chiefly near Ardrossan.

March 16, 1886.

The monthly gossip meeting of the Section was held on Tuesday evening, March 16. There was a good attendance of

Digitized by Google

ladies and gentlemen, and Mr. J. G. O. Tepper (Vice-President) occupied the chair. The exhibits comprised specimens in botany, geology, conchology, and ornithology. Dr. Magarey exhibited some shells, including a rare specimen (*Erato bimaculata*) obtained at Glenelg. Miss R. C. Fiveash showed some beautifully-executed paintings of native flowers, which had been chiefly collected at the outdoor meetings of the Section, and subsequently painted by that lady. Mr. R. H. Pulleine brought some handsome parrots and other birds from New South Wales, the Pacific Islands, and elsewhere. Other exhibits were a sponge, resembling the Turkey sponge of commerce, found at Kangaroo Island by Mr. A. Molineux, and some petrified wood from Victoria, by Mr. W. H. Selway, jun., who also showed a spider's nest formed of the leaf of a mallee growing at Kangaroo Island. Mr. Tepper gave an interesting sketch of a recent trip made to Kangaroo Island by a party of Government officials and others. Several mineral specimens were shown and described, in order to indicate the salient geological features of that portion of the colony. A number of plants peculiar to the island (several of which were exhibited) were also referred to in the sketch. An ironstone bomb brought from the island gave rise to some discussion, and Professor Tate gave the scientific explanation of the process of their formation. An inspection of the exhibits brought an interesting meeting to a close.

APRIL 20, 1886.

The monthly gossip meeting was held on this date. There was a large attendance. Dr. Cleland presided. The Chairman showed some fossils found in the cliffs at Port Willunga. Professor Tate brought a new South Australian shell (*Venus gallinula*). Mr. R. H. Pulleine exhibited some insects from the Northern Territory and Western Australia, and some shells from Encounter Bay, including a new *Pomatiopsis*. Mr. G. Collis, jun., showed a branch with flowers and fruit of *Momordica balsamina*, a plant indigenous to South Africa and the East Indies. Mr. J. G. O. Tepper brought a core of the Kangaroo Island grass-tree (*Xanthorrhœa Tatei*), and a large collection of dried plants from various parts of the world. The same gentleman also showed a representative collection of the orders of South Australian insects, and gave an address on the subject of his exhibit. The address caused some discussion, and it was decided to bring before the Royal Society the desirableness of securing for the Museum an exhibit illustrative of the economic entomology of this colony, particularly of insects injurious to plant life.

Digitized by Google

Winter Session.

May 18, 1886.

The first evening meeting of the winter session was held at the Public Library on Tuesday evening, May 18. Considering the inclemency of the weather there was a good attendance. Two new members were elected. The Chairman of the Section (Dr. Cleland) gave a short opening address dealing chiefly with the classification of flowers. He emphasised the importance of structure in scientific study, remarking that the mere knowledge of the names of plants was comparatively unimportant. Careful and minute observation as well as the power of expressing clearly what had been seen were necessary qualifications for the naturalist. In conclusion the members were urged to study carefully during the winter months the structure of the plants collected in the recent summer excursions. Mr. J. G. O. Tepper then read a short paper on the two first families of Coleoptera, specimens of which were handed round. The same gentleman exhibited some pressed plants from Kangaroo Island, showing the method of preparing specimens for transmission abroad. The most noticeable of these plants were *Boronia Edwardsii*, several varieties of *Ixodia*, *Bauera rubioides*, (the only representative in the colony of the Saxifrageæ), and a *Cassytha*, the stem of which was covered with glandular prominences. Mr. R. H. Pulleine showed a shell, *Trigonia margaritacea*, this being the first of the kind obtained alive on the South Australian coast. This specimen was secured at Encounter Bay, in eight fathoms of water. Mr. J. D. Lawson brought some dark brown caterpillars with large black heads and powerful mandibles. Some excellent paintings of Australian flowers were exhibited by Miss R. C. Fiveash.

June 15, 1886.

There was a fair attendance, and Dr. Cleland presided. The Chairman showed, as examples of mimicry, seeds of *Sollya heterophylla* and the seed-covering of *Pittosporum undulatum*, the former resembling the larva of an insect and the latter an isopod. Mr. R. H. Pulleine brought some shells which he had received from Mauritius and Madagascar. Mr. D. Gall showed a *Phyllopterix* found at Hallett's Cove, and a piece of clay shale from Tapley's Hill, in which the strata were very clearly defined. Mr. J. Aitken sent some fossil shells found at MacLaren Flat, and Mr. A Zietz showed an exhibit of a similar kind found near Campbelltown, casts of coral and nautilus being particularly good. Mr. J. G. O. Tepper exhibited specimens obtained at a depth of 50 to 60 feet at Echunga of por-

Digitized by Google

tions of eucalyptus, the wood having by chemical action been replaced by sulphuret of iron, but preserving its form. Mr. J. G. O. Tepper then read an interesting paper on "The Metamorphosis of Insects." After describing the distinguishing characteristics of the metamorphosis of the articulata, he stated that there were four stages in the existence of insects, viz., the egg, the larva, the pupa, and the imago or adult. The first of these resembled the seed in plants, and required warmth and moisture to ensure its vitality. The study of the development of the egg was worthy of the careful attention of microscopical students, and for this purpose a residence in the country was almost indispensable. The larva of the insect was compared to the vegetative stage in plants. It was mentioned that the sense of hearing possessed by the larva was very acute, and instances were given in illustration of this fact. The increase in size from birth to maturity of the larva varied from 200 to 72,000 times its own weight. The length of the life of the larva generally occupied the greater portion of insect existence. The various orders of insects were then dealt with in detail, it being shown that some of them possessed perfect and others imperfect metamorphosis. The lecturer confined his attention to the egg and the larva, there not being time to deal with the other two stages, and concluded by describing in detail the metamorphosis of several prominent local representatives of each order. Some discussion ensued on the termination of the paper, the latter being very favourably criticised. The Chairman read a letter from the General Director of the Library, &c., in reference to the suggestion emanating from the Field Naturalists' Section as to obtaining an exhibit of the economic entomology of South Australia for the Museum. The Museum Committee approved of the idea, but were unable to do much, owing to want of funds and space. They thought, however, that materials for such an exhibit might be gathered by the members of the Field Naturalists' Section.

JULY 20, 1886.

There was a small attendance, and Mr. J. G. O. Tepper, F.L.S., presided. The Chairman brought a collection of dayflying moths from the Museum, obtained chiefly from India, Queensland, and South Australia. Most of these closely resembled butterflies, and their timid nature, it was said, evidenced a high degree of intelligence. Mr. Tepper gave a short address on the individual specimens in the collection. Mr. W. Howchin, F.G.S., then gave a lecture on "The Selection, Mounting, and Sectioning of Microzoa." In an interesting conversational style the lecturer lucidly explained where to

Digitized by Google

find and how to treat the minuter forms of marine life, which were for convenience termed Microzoa. Until a generation ago little was known of these, and errors in classification were frequently made, Microzoa, chiefly in the form of Foraminifera, were to be found in abundance in sea-sand, which should be washed while wet so as to remove the salt. It should be then dried either in the sun or an oven, and when cool put into a basin and stirred, when the sand would sink and the shells float on the surface. Fossils were obtained from either soft or hard rocks. In case of the former, such as in clay or chalk, they could generally be obtained either by picking or washing with a soft brush and water. With the harder rocks, such as calcareous shale and limestone, mechanical means were often necessary for their removal. The difficulty would be lessened by searching for weathered surfaces and partings. The ballast of ships was a fruitful source whence to obtain fossils, as was also the erection of new buildings, such as at the Bank of Australasia, where New Zealand limestone could be obtained. After the material had been washed and dried the Microzoa were selected by means of sieves of varying meshes, thence transferred to a piece of black-painted wood, whence by means of a magnifying-glass specimens for mounting could be picked out with the help of a fine brush. Various methods of sectioning were then described, depending on the nature of the rock, which could be slit in a lathe or ground on a hone, so as to get it as thin as possible. Emery powder was also useful for this purpose. Examples of processes of mounting (previously prepared) were exhibited, but want of time prevented the lecturer giving an actual demonstration of the way to do this. At the close of the lecture (which was made more easily understood by means of apparatus) a discussion ensued, after which a vote of thanks was passed to Mr. Howchin, and the meeting closed.

AUGUST 17, 1886.

There was a good attendance. Dr. Cleland presided. Mr. J. G. O. Tepper exhibited two cases containing several hundred species of insects collected on Kangaroo Island in the month of March. He said that there were few among them that were not also found on the mainland, and specified grasshoppers with red wings, and a black variety of weevil (*Chrysolophus spectabilis*) that did not so occur. Miss Selway exhibited a basket of native plants, viz., *Ranunculus lappaceus*, *Gnaphalium japonicum*, and *Cheilanthes tenuifolium*, the whole forming a pleasing group. Mr. Tepper explained the habits of the plants shown. A curious-looking substance was also shown by Mr. Tepper, as having been used as a specific for rheumatism by some persons,

Digitized by Google

it having been carried in the pocket for that purpose for several years. It was a common potato, which had become quite unrecognisable through long use.

Dr. E. C. Stirling, M.A., M.D., read a paper upon "The Borderland of the Animal and Vegetable Kingdoms." The doctor began by saying that the statement that there was no difference between a horse and the tree that it stood under or the grass that it fed upon would doubtless appear startling; but if he simply enlarged the application of the illustration, and said that between animals and plants generally there were no essential differences, such as would in all cases enable us to distinguish the one from the other, the statement, however startling, would be found, he hoped, to be much more true than untrue. No doubt it was the case that if we concentrated our attention on the examples of plants and animals that were familiar to our ordinary thoughts, we should find no difficulty in discovering and describing many characters which distinguished the one from the other. But he was going to ask his hearers to withdraw their attention from such familiar examples, which were representative types of the highest members of the kingdoms of animals and plants, and to concentrate it upon a certain no-man's land, which lay midway between these two kingdoms. Here was a territory in dispute. The botanist and the zoologist had in turn claimed it and appropriated it, and whilst they had been still disputing over it another and a stronger claimant had arisen and carried it off. That claimant was the biologist, whose studies had compelled him to recognise the essential unity of life in whatever form it was found, and he therefore discountenanced any hard-and-fast line of demarcation between the old divisions of plants and animals, because he knew not where to draw the line. It was the biologist who had shown, and he thought conclusively, that the attribute called life, whatever its nature, was essentially the same whether it was manifested by those things called plants or by animals. To the biologist, therefore, belonged the future, and, aided by the special labours of the chemist and the physiologist, would perhaps some day lay bare the essential nature of that mysterious thing called life. He would, perhaps, in chemical formula, give expression to the subtle changes undergone by living tissues, at the nature of which we could only now guess, but which essentially contained the sought-for clue. If ever that came to pass he thought it would be found that the physical forces which underlay the existence and manifestation of life would be found not to differ in kind from the other physical forces of which we had at least some considerable knowledge. But he wished to impress upon his hearers that life was one-fold, and that whatever was its nature, it was essentially similar in its

Digitized by Google

characteristics throughout all living things, whether or not we chose to call some of them plants and some animals. The lecturer here proceeded to trace back the kingdoms of animals and plants through their highest representatives to those that were less developed. The lowest plant, like the lowest animal, would be found to consist of a translucent, jelly-like lump of a peculiar substance, which, when living, invariably exhibited certain phenomena. For this substance one of the names was protoplasm. Under such circumstances of apparent identity the question might well be asked why we should call one a plant and the other an animal. The difficulties in answering that question had led some naturalists to group certain of those lowly organisms into an intermediate kingdom, such as the Protista of Haeckel, but that seemed to be an attempt to cover up the difficulty rather than to unravel it. The protoplasm was the physical basis of life—in other words, it was "the mother stuff" out of which all things were made. All animals as well as plants were at one time of their existence composed entirely of it; every animal, as well as every plant, was at one time composed of a single microscopic globule of that protoplasmic substance; and as to the creatures in the border-land, they were never anything else but a speck of protoplasm. The lecturer here went into a description of the character of protoplasm, saying that, chemically speaking, it was a substance having on analysis a definite chemical composition, and giving approximately the same result as albumen or white of egg, but of course differing fundamentally from that substance in that it was living, while white of egg was not. But as its living phenomena were exhibited only so long as it preserved its chemical integrity, we were justified in considering that its manifestations of life were dependent upon the maintenance of a special chemical equilibrium. That equilibrium was destroyed by analysis. In whatever form protoplasm was found it contained the elements carbon, hydrogen, oxygen, and nitrogen united together in a very complete union, and to this complex substance the name "protein" had been given, and it might be said that all protoplasm was proteinaceous. The lecturer then dealt with the organization of plants, and their powers of absorption, digestion, and respiration. Plants were characterised by their capability of working up mere mineral or comparatively simple substances into complete organic substances, and amongst those particularly protein; and he then went on to examine whether similar generalization could be made in the case of animals, and he started with the generalization put forward by Cuvier that animals depended directly or indirectly upon plants for the nutrition of their bodies, viz., they were either herbivorous, or flesh-eaters. In the

Digitized by Google

language of Huxley the plant was the ideal worker who produced, and the animal the aristocrat who consumed in the mode of nutrition. In conclusion, he pointed out that with some plants there was not only a due supply of animal food necessary for their wellbeing, but also they had the essentially animal characteristic of being able to furnish or secrete a mixture of pepsin and acid very closely resembling the secretion of the animal stomach, with which the plants were able to digest their food. With such remarkable exceptions to the generalizations, the conclusion could be arrived at that there was no hard-and-fast line of demarcation between plants and animals, and that what differences did exist were of degree rather than kind.

At the conclusion the Chairman proposed a vote of thanks to the lecturer for bringing forward the philosophical side of the question, and said he thought it of great advantage to the Society to have the attention of the members directed to the matter.

In answer to questions, Dr. Stirling said there was no distinctive character of a plant that was not possessed by some animal, and no physical distinctive character of an animal that was not possessed by some plant.

SEPTEMBER 21, 1886.

There was a moderate attendance. Mr. J. G. O. Tepper, F.L.S., occupied the chair. Mr. W. T. Bednall read a paper upon the subject of "Bivalve Shells," carefully showing by the exhibition of specimens and by means of drawings on the blackboard the structure and internal economy of bivalve Mollusca. In his paper he said:—The Mollusca were divided into two great groups, the *Encephala*, possessing a head and protected by a spiral shell; and the *Acephala*, in which the animal was without a head, and was always protected by a shell, consisting of two pieces, applied to its sides, and connected by a hinge or ligament. He had chosen the *Acephala*, or bivalve shells, because they possessed a greater number of characteristic features for indentification than univalves. Bivalve shells were familiar to them all. The name implied that the shells comprising the division were composed of two pieces, called valves, joined together at the upper part. The apices of the shell were called the umbones, and it was from that point that the growth of the shell began. In some genera there was an impression in front of the umbones which was called the lunule; it was conspicuous in the genus *Venus*.

Digitized by Google

The ligament was a horny substance attached to the ridges on the hinge margin in the rear of the umbones, and served the purpose of holding the valves together. In combination with the ligament was the cartilage, which was set in furrows formed by the ligamental plates, or in pits along the hinge line. The province of the cartilage (which was elastic), was to open the valves as soon as the tension of the internal muscles had been relaxed. Lamarck had divided the bivalve shells into two general orders; the one he named *Dimyaria*, having two adductor muscles in each valve, and the other *Monomyaria*, having but one. These adductor muscles were composed of a contractile fibrous gristle, fastened firmly to the inner surface of each valve, and were the means by which the valves were closed. The Dimyaries comprised all the bivalves except the oyster family, part of the *Aviculidæ* and the genera *Tridacna* and *Mulleria*. The places where the muscles were fixed would be noted in Dimyary shells—after the animal has been removed—by well-defined areas or impressions (sometimes called scars) just below the hinge lamina—one in the anterior region of the valves, and the other in the posterior. These muscle scars were connected by a linear impression running parallel with the ventral margin of the shell a short distance from its edge. It was called the pallial line, and was caused by the attachment of the margin of the mantle of the animal. In some genera, however, this pallial line was not continuous, but was interrupted before it reached the posterior adductor impression by a receding bay. This was called the pallial sinus, and showed that the animal had retractile siphons. In the *Monomyaria* there was but one muscle to each valve, and the corresponding impression was near the centre of the shell. Bivalve shells were mostly equivalve, that was to say the right and left valves were of the same size and shape. In the oyster, however, the right valve was smallest, and in *Chamostrea* and *Corbula*—both found on our coast—the left. But *Chama*, also found on our coasts, had the valves indifferently right or left. The Monomyaries lay habitually on one side, and their shells, though really right and left, were termed upper and lower valves. Between the bivalve molluscs, having attached valves—as the oyster and *Spondylus*—and those which were free, that was, had the power of moving from one place to another, as *Venus*, *Cardium*, *Tellina*, &c., were placed those genera in which the liberty of the animal was circumscribed by its living in a burrow, and those which spun a byssus, by which the shell was attached to some foreign substance, such as the mussel. The correspondence between the shell and the animal of bivalves was so intimate that on examining an empty shell the particular order and family in which it should be

Digitized by Google

placed could be determined without seeing the soft parts. Bivalves live by breathing water through their gills, and were named *Lamellibranchiata* by De Blainville from the form of the breathing organ, which consists of two pairs of gills in the form of flat membranous plates, one pair placed on either side of the body. The Lamellibranchiates have been divided into two orders, the *Siphonida* and the *Asiphonida*. In the *Siphonida* the mollusc was provided with two tubes for the passage of the water required for respiration—called siphons —one incurrent, the other excurrent. In the *Asiphonida* there were merely two orifices for the introduction and the exclusion of the water. Although very much less numerous in species than the univalves, the bivalves were relatively much more numerous individually, the proportion of bivalves to univalves being about one-third. The coastline in the immediate neighbourhood of Adelaide, from the Port River to Marino, was a good stretch of sandy beach, and at all seasons of the year good specimens of many genera might easily be collected. The bivalves most generally found on that line of beach belonged to the following genera:—*Mactra*, *Hiatula*, *Tellina*, *Donacilla*, *Venus*, *Tapes*, *Chama*, *Lucina*, and *Solemya*, among the *Siphonida;* and *Mytilus*, *Modiola*, *Avicula*, *Arca*, and *Pecten*, among the *Asiphonida*; occasionally specimens of *Cardium*, *Anatina*, *Modiolaria*, and *Pectunculus* might be taken. In classifying shells it was necessary first to ascertain to what family they belonged, then to what genera. With regard to the specific distinctions they would find more difficulty, as the names bestowed upon shells by authors were sometimes very arbitrary. In the determination of the generic position of a shell, however, they would find the task much easier. The genera of bivalves had been characterised by the number and position of their hinge teeth, but the main points for them to look to were — whether the shell was dimyarian or monomyarian; whether the pallial line had a sinus or not; whether the ligament was external or internal; to note the number and direction of the teeth in the hinge; the equality or inequality of the valves; and also whether the shell was pearly or not.

Professor Tate, in the course of a few remarks upon the instructive character of the paper, said had he known its exact nature he could have brought some living shells in water showing the action of the gills. He had been directing his attention for some weeks to the development of the embryos of mollusca, especially the bivalves, of which there was all to learn.

Digitized by Google

ANNUAL MEETING.

October 19, 1886.

The annual meeting was held on Tuesday evening, October 19. There was a very large attendance of ladies and gentlemen, and a most interesting display of exhibits of natural history, living and dead. Amongst the most notable were live specimens obtained from the Port Creek by a trawling party; collection of shells from various parts of the world, lent by Mr. W. T. Bednall; natural history objects, lent by Dr. Wylde (being paintings and exhibits of various curious fish, &c); fossils, Victorian native bread, and other exhibits, by Professor Tate; complete herbarium of plants indigenous to Ardrossan, by Mr. J. G. O. Tepper; moths and butterflies, by Mr. E. Guest; beetles, butterflies, and stuffed birds, by Mr. R. H. Pulleine; Victorian ferns, by Mr. W. H. Selway, jun.; native fibre plants, shown by Mr. E. G. Millard; dried native flowers, by Mr. A. F. Robin; some plants characteristic of the desert flora near Lake Gilles, shown by Dr. Cleland; living native plants and wild flowers, by Miss C. A. Selway; a large collection of watercolor drawings of native flora, by Miss R. C. Fiveash; silkworm cocoons, raw silk, &c., by Miss Tepper. There were also several fine microscopes in the room belonging to members of the Microscopical Section. It was decided that the future annual meetings should be held in September instead of October. The Hon. Secretary read the annual report and balance-sheet, which were adopted. The following is the

ANNUAL REPORT OF THE COMMITTEE.

The Section having now completed the third year of its existence may fairly claim to be successfully established.

During the year sixteen excursions have been held, five of which have taken place on holidays, and eleven on Saturdays. No Saturday excursions were arranged for in the winter months, as last year's experience did not warrant a repetition of these meetings, which were not a success on account of inclement weather. Outdoor meetings have, however, been held on public holidays throughout the year, the weather on each occasion being very favourable.

Eleven evening meetings have been held. These include gossip meetings in the summer months—a new departure, and one which proved fairly successful.

Lectures have been contributed by the following gentlemen, viz.:—Mr. J. G. O. Tepper, F.L.S.; Dr. E. C. Stirling, M.A., M.P.; Mr. W. Howchin, F.G.S.; and Mr. W. T. Bednall. At the close of the winter session on October 19, a conversazione was held, which passed off very satisfactorily.

Digitized by Google

The Committee take this opportunity of urging members to bring or send exhibits to the evening meetings. At present the contributors are for the most part limited to a few members, and it is desirable that all should take a practical interest in this part of the Section's work.

The attendance at both indoor and outdoor meetings, especially the latter, has been well sustained during the year.

Twenty new members have joined the Section this year, as against thirty last season.

The Committee desire to acknowledge with thanks the receipt regularly of *The Victorian Naturalist*—the monthly publication of the Field Naturalists' Club of Victoria.

The Committee are pleased to state that owing to careful management the financial position of the Section is much more satisfactory than in previous years, the receipts from subscriptions having more than covered the expenses. The latter have been £19 15s. 3d., while the subscriptions amount to £25. The Section promises, therefore, to be entirely self-supporting.

For the Committee,

W. L. Cleland, Chairman.

W. H. Selway, Jun., Hon. Sec.

Officers for current year were elected as follows:—Chairman, Mr. J. G. O. Tepper, F.L.S.; Vice-Chairmen, Dr. Cleland and Rev. J. McEwin; Committee, Professor Tate, Dr. Magarey, Messrs. D. J. Adcock, Harry Dean, D. Fleming, J. R. Gurner, G. G. Mayo, and A. Molineux; Hon. Secretary, Mr. W. H. Selway, jun.

CHAIRMAN'S ADDRESS.

Dr. Cleland, in his address, said:—This evening we complete the third year of the existence of this Field Naturalists' Section of the Royal Society of South Australia, and we have reason to congratulate ourselves on the number and variety of our accomplished undertakings as shown by the Secretary's report on the past year. We may also compliment our Secretary on having made our expenditure balance with our income, a feat that has not been performed during any previous year. But whilst there is thus much on which we may plume ourselves, there is another feature which is not so satisfactory. I refer to the small number of members who appear to be working or even interesting themselves in matters which are specially within the province of the Section. There may be many reasons for this, but I think one principal reason is that many make a false start. It is certainly putting the cart before the horse to study the specific characters of an object before the generic ones are known, or, more comprehensive still, those pertaining to its natural order and class. As a result the would-be student finds the difficulties in the way almost in-

Digitized by Google

superable, and throws the pursuit up in disgust. Although the self-taught man has often many qualities that command our respect, yet it not unfrequently happens that his information is not always trustworthy, and at some crucial point and time will fail. This is the result of a want of systematic grounding in the first place. It is essential for us to remember that before we can become workers it is necessary that we shall have been students. Having the principles of classification well impressed on your minds, the study of specific characters will cease to overwhelm you with their minutiæ, and your labours will become a pleasure. There is perhaps no study more calculated to cultivate an accurate and scientific habit of observation and comparison; but from this very fact, there is also a danger of the mental outlook becoming contracted, unless at the same time the general relationships and affinities of the subject to the cosmos as a whole are studied. Scientific facts standing alone and not viewed in their relation to other facts or groups of facts, may be interesting, but are comparatively useless. Let me take as an illustration an example from my own particular profession. For instance, there is situated in the human brain a structure of a reddish colour, and about the size of a small cherry stone. Anatomists and physiologists have for a long time been puzzled to know what was the significance or use of this little body, known as the pineal gland or body. It is solitary, and is situated exactly in the middle line, and is buried in the central part of the brain substance. In lizards this structure is more developed, and in them consists of two portions—a deeper one corresponding in position to the portion in the human brain, and a more superficial portion nearer the top of the cranium. In vertebrates it was, until quite lately, thought to be most developed in the blind-worm (*Anguis*). It has remained, however, for Mr. Baldwin Spencer, of Oxford University, to demonstrate in the pineal body of a lizard-like vertebrate peculiar to New Zealand, called *Hatteria punctata*, the structure of an invertebrate eye. It is interesting also to note that this lizard (Hatteria), is the only living representative of the genus, which can, however, boast of a very ancient pedigree. It is probably an archaic form rapidly approaching extinction. Those of you interested in the matter may see a full account of the subject in one of the May numbers of *Nature*, where the structure is illustrated. The question then arose, what was the meaning of an invertebrate eye being placed in the centre of the brain of a vertebrate animal where it could not possibly be of any use. At the same time the animal had the usual pair of eyes built upon the common vertebrate type. And again, even amongst the invertebrata the organs of sight are generally paired, whereas here

Digitized by Google

was a visual organ evidently meant to be unpaired by being exactly placed in the middle line. If we again consult comparative embryology, we find that the embryo of a molluscous animal called Ascidian or Tunicate possesses a similar unpaired centrally-placed visual organ as you may see figured in Balfour's book. Now here we have a string of facts more or less interesting according to our individual tastes, but as long as we view them as isolated facts they are to us nothing more than so many scraps of knowledge. If, however, we apply to them a law which has been carefully promulgated and worked out by Darwin, these facts cease to be isolated, but we find them forming links in a long chain or series of chains uniting man and the lizard-like Hatteria on the vertebrate side, and the Tunicate on the invertebrate, to some common ancestral origin in the remote past. And coming round to where we began, we see in this pineal body of the brain the morphological homologue of the unpaired centrally placed eye of a very primitive type of organic life, that was probably built neither on the vertebrate nor invertebrate type. And if in studying morphology, or the science of structure, we are impressed with the wonderful unity and persistence of structural type, on looking in another direction we are also equally impressed with the interdependence of all parts of nature one on the other. The physical features of a country are not more dependent on its geological formation than is its flora. Take as an example the country on either side of the upper portion of Spencer Gulf, and continued northward, more or less, on either side of Lake Torrens. To the eastward we have the magnificent physical features of the Flinders Range, culminating in Mount Browne, as one of the highest, if not the highest, point in South Australia. To the westward, standing in marked contrast, are the low, flat, table-topped hills constituting the remnants of that enormous deposit known as the Desert Sandstone—the one formed of older clayey rocks, in part metamorphic; the other of more recent formations, including extensive beds of organic remains. The plains formed by the denudation of the Flinders Range and chiefly occupying its eastern side resemble the Adelaide Plain to a large extent in geological composition, and where climate permits also in the nature of its flora. We see the same tendency to formation of deep-bedded watercourses, with steep, precipitous sides, the banks falling in perpendicular masses as in our River Torrens. We notice also all the way to Hergott that these watercourses are invariably lined with large eucalypts. Taking a corresponding portion of the country westward with the same climate, we notice at once that the watercourses are shallow, with gradually sloping banks, and the eucalypts are conspicuous by their absence. Instead, we find

Digitized by Google

miall tree and the sandalwood and the sage-coloured Eremophila. Or, to take an example nearer home, how marked is the abrupt limitation of the stringybark and heath-like plants to the sandstone capping of the Mount Lofty Range. Whilst lower down on the richer soils from the slaty rocks, we find other species of eucalypts and casuarina. Then in the same way as the flora is dependent on the geological formation, other things being equal, so also we find the fauna dependent on the character of the flora. With a certain class of plants we find certain insects present, and following the insects and the seeds and fruits, we find certain characteristic birds. The large herbivora, again, seem to be more susceptible of climatic changes, for unless abundance of bulky food can be grown, these animals are unable to exist. Hence in that rainless region to the westward of Lake Torrens we find an absence of any large native animal. This, however, was not always the case, for, judging by the fossiliferous remains, that portion of Australia must at one time have been clothed with a tropical vegetation which supported a gigantic fauna. But as the climate changed and the rainfall lessened, the vegetation and that which it nourished, disappeared, or was buried to appear again in geological formations. And at the present day we find as fossils, the flora and, almost side by side with it, that which fed on it, namely, the remains of a gigantic kangaroo, with a skull measuring some four feet in length, whilst the teeth of a carnivorous marsupial exceeding in size those of the largest lion, speaks grimly of the quantity and size of the herb-eating animals. The object of these remarks has not been to lay certain items of knowledge before you, but rather for the purpose of illustrating the great truth of the unity of Nature, and how it is impossible rightly to study one branch of science without regard to its bearings on others. The different sciences are but parts of a whole, and if we lose sight of the plan we resemble one who would fix his attention on a particular thread in a carpet and disregard the pattern. Classification is essential to help our limited faculties, but it should always remain our servant, and we should never become slaves to it. Taking it as our guide through the mazes of natural science, we shall find it opening up to us vistas of most interesting knowledge and employment, knowledge free and accessible to all who are willing to approach our venerable mother, the earth, in a spirit becoming to her latest-developed and most favoured children. As field naturalists you have already taken the first step, and in proportion as you cling to the skirts of Nature so will be your future success. The Greeks, with their intuitive appreciation of phenomena, made Phusis, or Nature, feminine, and in keeping with the sex, if you would win her secrets you must

Digitized by Google

woo her with an untiring devotion. As wooers, then, we should sally forth on our excursions, and if we return empty-handed we may be sure the fault lies with us and not at Dame Nature's door.

The conversazione which took place at the close of the formal business was the first the Society has held, and proved decidedly enjoyable.

Digitized by Google

FIELD NATURALISTS' SECTION OF THE ROYAL SOCIETY OF SOUTH AUSTRALIA.

RECEIPTS AND EXPENDITURE FOR THE YEAR ENDING 31ST OCTOBER, 1886.

Dr. Receipts.	£	s.	d.	Cr. Expenditure.	£	s.	d.	£	s.	d.
To Grant from Royal Society	20	0	0	By Printing—W. K. Thomas & Co. ...	0	12	6			
" Subscriptions	25	0	0	" " Whillas & Ormiston ...	10	1	6			
" Surplus on Excursions	0	10	0	" Postages and Sundries...	9	1	3			
								19	15	3
				" Subscriptions handed over to Hon. Sec. Royal Society				25	0	0
				" Balance in Hand				0	14	9
	£45	10	0					£45	10	0

Audited and found correct,

LIONEL C. E. GEE,
A. F. ROBIN, } Auditors.

Adelaide, 21st September, 1886.

W. H. SELWAY, Jun., Hon. Sec.

Digitized by Google

LIST OF MEMBERS

OF

FIELD NATURALISTS' SECTION

OF THE

ROYAL SOCIETY OF SOUTH AUSTRALIA

For year ending October 31, 1886.

Those marked † are Fellows of the Royal Society, S.A.
Those before which the letter F appears are foundation members.

†FAdamson, Mr. D. B., Angas-street, Adelaide.
†FAdcock, Mr. D. J., Currie-street, Adelaide.
Addison, Mr. H. M., Victoria-square, Adelaide.
FAitken, Mr. J., Maclaren Flat.
Allen, Mr. H., Rundle-street, Adelaide.
Allison, Mr. J. W., Unley.
Anderson, Mr. T. G., N.E. Road, Medindie.
Ashton, Mr. J., Hydraulic Engineer's Office, Adelaide.
FBaker, Mr. W. H., Norwood.
Baumann, Mr. C. B., Messrs. Harris, Scarfe, & Co., Gawler-place.
Beazley, Mr. Geo., The Museum, Adelaide.
Bee, Mr. J., Hydraulic Engineer's Office, Adelaide.
Best, Mr. D. (Hon. Memb.), 16, Little Collins-street E., Melbourne.
Bevilaqua, Mr. L. W., Fullarton.
FBeythien, Mr. E., Moonta.
FBishop, Mr. J. F., Adelaide.
FBottomley, Mr. W. D., Savings Bank, Adelaide.
Bowen, Mr. F. C., Freeman-street, Adelaide.
Bradley, Mr. E. J., Hydraulic Engineer's Office, Adelaide.
Brook, Mr. W. J., J.P., Pirie-street, Adelaide.
Bruce, Mr. J., Works and Buildings Department, Adelaide.
†FBruer, Mr. J. J., King William-street, Adelaide.
†Bussell, Mr. J. W., F.R.M.S., Railway Station, Adelaide.
Chipp, Mr. H. E., Currie-street, Adelaide.
†FCleland, Dr. W. L., Parkside.
Cleland, Mrs. W. L. Parkside.
Colbourne, Rev. J., Hyde Park, Unley.
FCollis, Mr. G., jun., Gawler-place, Adelaide.
Coppen, Mr. E., c/o Mrs. Symes, Grenfell-street, Adelaide.
FDane, Mr. F. N., Eliza-street, Adelaide.
†FDavies, Mr. E., Flinders-street Adelaide.
FDean, Mr. H., jun., Carrington-street, Adelaide.
Dixon, Mr. S., c/o Messrs. Luxmoore & Co., Limited, Adelaide.
†FDobbie, Mr. A. W., Gawler-place, Adelaide.
Doughty, Mr. G. F., Government Offices, Adelaide.
†FEvans, Mr. T., King William-street, Adelaide.
FFabian, Mr. T., City Treasurer, Adelaide.

Digitized by Google

†rFarrar, Mr. G. E., C.E., Clare.
Fiveash, Mr. F. A., c/o Messrs. Sands & McDougall, King William-street, Adelaide.
Fiveash, Miss R. C., Ward-street, North Adelaide.
†rFleming, Mr. D., Mackinnon-parade, North Adelaide,
†rFletcher, Rev. W. R., M.A., North-terrace, Kent Town.
Fornachon, Mr. C. L. F., Y.M.C.A., Adelaide.
rFrench, Rev. Canon, M.A., Glenelg.
rFuller, Mr. W., University, Adelaide.
†Gall, Mr. D., Tynte-street, North Adelaide.
†Gee, Mr. L. C. E., Survey Department, Adelaide.
Gittins, Mr. H., Edward-street, Norwood.
Grasby, Mr. W. C., Payneham.
Griffiths, Mr. J., Public School, Walkerville.
Guest, Mr. E. (Hon. Memb.), Balhannah.
Gurner, Mr. J. R., North-terrace, Adelaide.
Hammond, Mr. H., Childers-street, North Adelaide.
rHampson, H., Leigh-street, Adelaide.
Hill, Mr. C., Alix House, South-terrace, Adelaide.
Hill, Mr. W. H., Quorn.
†rHowchin, Mr. W., F.G.S., Goodwood E.
rHussey, Mr. G. F., G.P.O., Adelaide.
Jacobs, Mr. Geo. W., 27, Currie-street, Adelaide.
Jameson, Mr. Geo. E., Union Bank, Adelaide.
Jobson, Mr. C., Beetaloo.
†Johnson, Mr. J. A., Franklin-street, Adelaide.
Johnson, Miss, "St. Catherine's," Prospect.
†Kelly, Rev. B., Mount Barker.
†Knight, Mr. G. C., Gover-street, North Adelaide.
Langdon, Mr. J. H. C., Town Hall, Adelaide.
Lawrance, Mr. V., J.P., Pirie-street, Adelaide.
Lawrance, Mr. C., Lefevre-terrace, North Adelaide.
Lawson, Mr. J. D., Divett-place, Adelaide.
rLeader, Mr. C. S., King William-street, Adelaide.
Light, Mr. W., Wentworth, N.S.W.
Lindow, Mr. T. W., Messrs. J. S. Sanders & Co., Hindley-street, Adelaide.
rLock, Mr. E. H., *Register* Office, Adelaide.
†rMagarey, Dr. S. J., North-terrace, Adelaide.
†rMayo, Mr. G. G., Pirie-street, Adelaide.
rMcEwin, Rev. J., *Colonist* Office, Currie-street, Adelaide.
†rMestayer, Mr. R. L., C.E., F.R.M.S., Hydraulic Engineer, Adelaide.
†rMolineux, Mr. A., Kent Town.
rMolineux, Mr. A. E., Kent Town.
†rMunton, Mr. H. St., North-terrace, Adelaide.
Newman, Mr. J. H., 12, Currie-street, Adelaide.
O'Connor, Mr. M. J., Public Library, Adelaide.
Padman, Mr. J. E., Messrs. M. Goode & Co., Grenfell-street, Adelaide.
Phillips, Professor, M.A., University, Adelaide.
†Poole, Mr. W. B., Savings Bank, Adelaide.
†rPoulton, Dr. B., Adelaide Hospital, Adelaide.
Pulleine, Mr. R. H., Public Library, Adelaide.
Read, Mr. Geo. A. G., Telegraph Office, Adelaide.
Robertson, Mr. J., Angas-street, Adelaide.
Robertson, Dr. W., North-terrace, Adelaide.
†Robin, Mr. A. F., *Advertiser* Office, Adelaide.
rRogers, Mr. A. L., 3, Rundle-street, Adelaide.
Rosenhain, Mr. O. W., Box 125, G.P.O., Adelaide.
rSansom, Mr. P., Currie-street, Adelaide.

Digitized by Google

Saunders, Mr. F., Hydraulic Engineer's Office, Adelaide.
‡Selway, Mr. W. H., jun., The Treasury, Adelaide.
†Smeaton, Mr. S., B.A., Bridgeport.
†Smyth, Mr. J. T., B.A., B.Sc., Model School, Norwood.
‡Sowden, Mr. W. J., *Register* Office, Adelaide.
†‡Stirling, Dr. E. C., M.A., Lefevre-terrace, North Adelaide.
†‡Tate, Professor, F.G.S., F.L.S., Buxton-street, North Adelaide.
Taylor, Mr. G., South-terrace, Adelaide.
†‡Tepper, Mr. J. G. O., F.L.S., Somerset-place, Norwood.
Thwaites, Mr. F. J., National Bank, Adelaide.
†Todd, Mr. C., C.M.G., Postmaster-General, Adelaide.
Upton, Mr. H., King William-street, Adelaide.
†Varley, Mr. A. K., Kirtonville, Mount Gambier.
†Wainwright, Mr. E. H., Collegiate School of St. Peter, Hackney.
Watts, Mr. H. (Hon. Memb.), Wellington-street, Collingwood, Melbourne.
Webb, Mr. W. H., William-street, Norwood.
‡Whatham, Mr. F. G., Freeman-street, Adelaide.
‡Whitney, Mr. F. M., Messrs. J. Colton & Co., Adelaide.
†‡Whittell, Dr. H. T., F.R.M.S., North Adelaide.
Wilson, Mr. J., F.E.I.S., Goodwood.
Wilson, Mr. S. P., Uraidla.
Wiseman, Mr. A., Freeman-street, Adelaide.
Witherick, Mr. J., Waymouth-street, Adelaide.
†Wragge, Mr. C., F.R.G.S., The Observatory, Brisbane.
†Zietz, Mr. A., Museum, Adelaide.

Digitized by Google

MICROSCOPICAL SECTION

OF THE

Royal Society of South Australia.

ANNUAL REPORT.

The Committee, in presenting their First Annual Report, have much pleasure in stating that they have every reason to believe that the Section has met a want which was felt for some time in bringing together those interested in microscopy for mutual instruction and assistance. The interest in the work of the Section has gradually increased during the session, and although as yet little has been done in the way of furthering scientific knowledge, yet it is to be hoped that as the Section becomes established as a special branch of the Royal Society, the number of members who will devote their time and attention to some special subject will increase, and that some additions will ultimately be made to the cause of microscopical progress and research.

The number of members on the roll at the present time is 36, of whom five are resident in the country. The average attendance has been 17.

The Section was inaugurated by a conversazione held on March 9, which was numerously attended by members and friends. Since then meetings have been held regularly every month as follows:—

April 13. Gossip meeting and exhibition of accessories.
May 11. Discussion on mounting in balsam without pressure.
June 8. Remarks on plates of Holothuria, by the Secretary.
July 13. Paper on dry mounting, by R. L. Mestayer, Esq.
Aug. 10. Remarks on Coccidæ of South Australia, by F. S. Crawford, Esq.

A statement of receipts and disbursements is herewith submitted, showing receipts, £11 2s. 6d., payments, £10 18s. 11d., leaving a balance of 8s. 7d., so that the Section, so far, has been self-supporting.

Digitized by Google

MICROSCOPICAL SECTION OF ROYAL SOCIETY OF SOUTH AUSTRALIA.

Receipts and Disbursements for Year Ending September 30, 1886.

Dr. Receipts.	£	s.	d.	£	s.	d.
Members' Subscription, 16 @ 10s... ..	8	0	0			
" 12 " 5s... ..	3	0	0			
" 1 " 2s. 6d. ..	0	2	6			
				11	2	6
				£11	2	6

Cr. Payments.	£	s.	d.
Hire of Room for Preliminary Meeting..	0	5	0
Lamps, one and a-half dozen	1	2	6
Deed Box, Drum for Kerosine, &c.	1	3	6
Hire of Chairs for Conversazione	0	18	0
Magazines, to December 31, 1886	0	13	6
Stationery	1	4	8
Advertising	1	0	5
Printing	1	12	6
Postages	1	14	10
Caretaker for Attendance..	1	4	0
Balance in Hand	0	3	7
	£11	2	6

Audited and found correct,

J. G. ASHTON,
W. T. FLINT, } Auditors.

J. W. BUSSELL, Hon. Secretary.

Digitized by Google

Digitized by Google

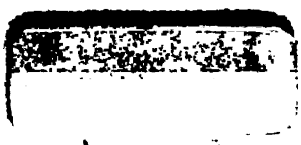
Digitized by Google

Digitized by Google

Digitized by Google

Digitized by Google

Digitized by Google



Digitized by Google